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# SKIN MALIGNANCY[1]

## COMMENTS ON THERAPY

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THE treatment of malignancy is now a most important specialty embracing several other specialties in general science and in medicine. The treatment of skin malignancies should also presuppose a special knowledge of dermatology.

Up to 1895, surgery, by means of caustics, cautery, or the scalpel, held the undisputed field of therapy in the combat against cancer, which was generally believed to be of local origin. Then radiation entered into the field, and, with it, came an ever increasing accumulation of facts concerning the natural history of neoplasms, and the effects of radiation of various wave lengths, from the hertzian to the gamma field, upon the elements of normal and diseased living tissue.

The result of this thirty-five-year development has been to limit the field of operative surgery in the therapy of malignancies, and especially of skin malignancies, to a very large extent.

Expert application of the new knowledge requires long and special study and training along many different lines, including the physics, chemistry, and biology of rays of all wave lengths, and a good foundation in general medicine, especially in pathology and roentgen diagnosis. The physician who has not had special training and experience in these branches of science should not undertake to treat malignancies of the skin or other organs. Many, many times ill-advised surgery or insufficient radiation has spelled the death-sentence of credulous patients who could have been saved by expert treatment begun early.

The practice in these days of operating an X-ray machine solely or principally upon knowledge gleaned from the salesman, and of applying radon or radium without proper training in its use, cannot be too strongly condemned and should not be permitted. The public and the profession must be educated to the importance of giving proper recognition to the trained radiologist and specialist in neoplastic diseases.

The therapy of cancer, as of other diseases, depends largely upon its etiology and pathology.

Is cancer a constitutional or a local disease in its beginning?

For many years the answer has been that it is local; hence, removal by surgery was the cure.

But there appears to be more and more of a tendency to regard it at least as an inherited susceptibility and to accept wholly or in part the conclusions of Slye from her

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classical work on mice. Other possible constitutional factors are being more and more seriously considered.

A degree of immunity of different organs against, or of susceptibility to, certain types or grades of cancer seems to exist. Why is squamous-cell carcinoma the type usually found in the cervix uteri and not in the fundus uteri? And, on the other hand, why is adenocarcinoma almost invariably limited to the fundus? Why is basal-cell carcinoma found in the skin of the face more frequently than the squamous-cell type, while on the back of the hand we find only the squamous cell? Why is a sweat gland carcinoma rarely found, and, when it is, why does it usually involve the face? Why do metastases vary so much in their usual distribution? An adenocarcinoma of the breast, for instance, will frequently metastasize to the lungs, the liver, the vertebræ, the humeri, or the femora, but very rarely to the spleen, or to the bones below the elbows or knees. In bone involvement, in such cases, the metastases must surely be blood-borne, and, if so, why is there apparently selective involvement? The cancer cells or virus must be distributed everywhere. Can we explain distribution of metastases entirely upon an anatomical or a physiological basis? If so, how explain the early and almost certain metastasis from a Grade 3 or 4 squamous-cell carcinoma of the cervix and a very delayed and uncertain metastasis from a Grade 1 or 2 squamous carcinoma of the same region? Why does not a basal-cell carcinoma of the skin metastasize and why does a squamous cell always metastasize? Why does a melanoma metastasize so much more rapidly and diffusely than a squamous cell of the skin? Evidently grade of differentiation and type of cell play rôles in metastasis that are independent of the anatomy of the parts involved. May we not say that certain organs and tissues of the body possibly carry within their cells a certain susceptibility, probably inherited, for certain neoplasms, just as certain organs and tissues exhibit great susceptibility for the action of certain drugs?

These considerations must be borne in mind when we are treating carcinoma. We make a five- or ten-year "cure," then a neoplasm appears in the treated field or in some other field. Has a cancer cell lain dormant all these years, or is it a sudden mutation of a cell which carried within itself a something, a susceptibility, to change into a life of malignant riotry? If so, we must do something more than surgery or radiation to prevent the handing down of the disease to posterity. The generation involved must not reproduce, or, according to Slye, it must be bred out with immune individuals for two generations.

But the present religious, moral, and social attitude of the race forbids anything of this kind. To gain a knowledge of heredity in the human would mean the education of the people to the necessity for periodical health and general postmortem examinations, and the control of reproduction. This, of course, is not likely to take place for several generations yet, though there is already much sentiment for birth-control, which, if intelligently carried out, would be in the right direction of progress in cancer control.

There are certain conditions which seem to contain within themselves elements which finally lead to cancer. Xeroderma pigmentosa which appears after the first exposure to sunlight is one of these conditions. The sunlight seems to be a specific irritant or stimulant for assisting in the development of this disease. The susceptibility of the cells is probably hereditary. The sun's rays simply activate the chemical action which changes the susceptibility to an actual malignant change. "Farmer's" or "sailor's skin," with malignant change, develops after long and frequent exposures to the sun's rays. Cancers of the skin also develop after long and constant exposure to certain tars, oils,

and soots. These malignancies are said to be due to chronic irritation, which for many years has been considered as a cause of cancer. Arsenical dermatoses leading to malignancy are similar. Is it not possible that these are *specific* irritations which finally result in cancer in individuals who carry susceptible cells? Be it noted that long exposures to these agents do not always cause cancer. Chronic irritations of a general character do not always lead to cancer, by any means. May not the development of these cancers be ascribed to inherited susceptibility, hastened by specific agents which develop within the cell a chemical or electrical change which is sufficient to overbalance the susceptibility and develop cancer as we know it?

The diagnosis of malignancy of the skin is generally not very difficult, if one checks it with a properly made biopsy studied by an expert pathologist. Without this, many serious mistakes are made, especially by the inexperienced, as well as occasionally by the experienced. When we consider that mistakes of this kind are not easily, if at all, corrected, one must realize the importance of biopsy and expert diagnosis of skin lesions before undertaking any form of treatment.

Lupus vulgaris and erythematosus and tuberculous adenomas, blastomycosis, moles and nevi of various types, sarcoids and morphea, primary or tertiary (gummatous) forms of syphilis and granuloma pyogenicum (especially on the lower lip), sebaceous cysts, keloids, neurofibromas, seborrheic, senile, or actinic keratoses, fatty tumors—all these are often misdiagnosed as malignancies. Not infrequently malignancy develops in a lupus of the skin or a gumma of the tongue, or in a mole or other nevus, keratosis, scar, etc., and must be recognized and receive proper treatment. The first requisite in the treatment of cancer is as thoroughly correct a diagnosis as possible.

The clinical appearance of melanotic growths, together with the very great danger of biopsy or operative interference with the cold knife, must be appreciated. Indeed, we would advise the same caution in connection with any non-pigmented mole or nevus. Such a one often contains metastatic melanotic possibilities not apparent upon microscopic study.

### BIOPSY

There is an honest difference of opinion about the safety of biopsies in cancer. For statistical purposes, a pre-operative biopsy is essential, but it must be of sufficient area to represent fairly the characteristics of the tumor and its growing border. The French school, headed by Regaud, insists upon a biopsy in every case before applying radium, not alone for statistical purposes, but especially to determine the type and grade and to learn something about the radiosensitivity of the tumor, so that radiation may be applied more intelligently. Most other cancer centers practise biopsy at least for diagnostic purposes. Many radiotherapists advise against it. It has been shown by Wood and others how easy it is to squeeze cancer cells out of the tumor into lymph spaces. It is probable, too, that local anesthetics, injected to relieve the pain of a biopsy, may be the means of forcing cancer cells into the circulation. Personally, we have never had proof of causing metastasis by biopsy, but we have seen many metastatic sequences after operative interference in moles by the cold scalpel. We have not seen metastases follow their removal by surgical diathermy except in one case of melanotic cancer, which recently came under our care. A woman fifty years of age had a black pigmented mole on her temple, which started to grow. She consulted a physician, who destroyed it by desiccation. Three weeks after, when the wound was healed, a second growth appeared alongside

the scar. The patient was then referred to a surgeon, who removed the growth with the radio-knife. Another nodule developed near the scar and one in the eyelid, and she was referred to us. We applied a large radium pack, filtered through 1.5 mm. of platinum and 2 cm. of wax and sawdust, over a large part of the same side of the face and scalp for five days. The tumors disappeared, but three months later another appeared on her leg, and rapidly involved the whole skin and the internal organs. It is probable the original lesion was not treated widely enough, or that the anesthetic was injected too close to the growth. We judge this from the fact that the first secondary growths appeared in the near neighborhood of the primary lesion. No more appeared there after the thorough radium treatment (which, by the way, indicated a sensitivity to radium which is denied by some radiologists to-day).

It has been shown that particles of melanin extend quite a distance in the skin beyond the melanotic growths and rather deeply below the surface, so that these growths would better be treated with radium packs before or after removal, and the surgical diathermy should be of wide and deep extent. This can be done with radio-knife and provide a good specimen for microscopic examination.

In the malignant lymphomas, biopsy is frequently required. Inasmuch as these tumors are probably of lymphocytic origin, and are more or less constitutional, surgical interference with the cold scalpel for biopsy purposes probably makes no difference in the outcome of the disease. The biopsy should be made in practically all cases if the tumor is easily accessible.

## TREATMENT

The principal methods of treatment in vogue in the last thirty years include the following:

(1) Caustics, such as pyrogallic acid, arsenious acid, zinc chloride, potassium hydrate, freezing with carbonic snow, Sherwell's acid nitrate of mercury treatment after curetting, etc.

(2) Intravenous injections of glandular extracts, serums, toxins, vaccines (Doyen), dyes and other chemicals such as lead, gold, bismuth, etc.

(3) Surgery—by means of the cold knife wide excision, by the radio-knife, fulguration, desiccation, electrocoagulation, actual cautery.

(4) Radiation by X-ray, mesothorium, or radium.

### CAUSTICS

Caustics of various kinds in the form of pastes, applied without preliminary operative interference such as curettage, have seldom been used during the last few years, except by the quack and illegal practitioners, who continue to attract the credulous and unsophisticated public by their alluring advertising and propaganda.

This treatment could be quite effectual in basal-cell types of growths which do not metastasize, but might be worse than useless in the much more malignant metastasizing squamous-cell, nevo-, or melanotic carcinomas. Likewise, in any of the sarcomas and malignant lymphomas it would be wholly ineffectual. The disadvantages of chemical caustics are: (1) that their action below the surface cannot be very accurately observed or controlled; (2) that they destroy all tissue, pathologic as well as normal, with which they come in contact; (3) that they exercise no influence in involved, but apparently normal, tissue, outside their field of caustic action; (4) that their action is marked by long-continued pain. The action of carbonic snow is too superficial anyway to be considered as an effective agent in any malignancy. With our present-day knowledge of cancer and

effectual means of combating it, we believe caustics should have no place in the armamentarium in the fight against malignant diseases of the skin.

### INTRAVENOUS INJECTIONS OF GLANDULAR EXTRACTS, SERUMS, TOXINS, VACCINES (DOYEN), LEAD, GOLD, BISMUTH, AND DYES

For many years all of these agents have been tried in one form or another in cancer, and while occasional more or less reliable reports have been published regarding Coley's toxins and the Blair Bell lead treatment, no authentic reports of cures have been made concerning any of the other agents.

Efforts are being made to find an organ tissue, a dye, or other chemical which may be taken up by the living cancer cell and which will break down its resistance, but as yet there has been no success in this line of research. It is possible that something may be found, which, when injected, may so sensitize or lower the resistance of a radio-resistant cancer that the latter may yield to roentgen or gamma radiation, especially if we can use it in much higher voltage and in much larger quantity of energy, as seems well within the range of possibilities.

### SHOULD SURGERY BE EMPLOYED FOR CURE OF MALIGNANT GROWTHS OF THE SKIN?

The surgeon for so many generations has claimed this field as his, that it is difficult for him to recognize and yield to a competitor. He has removed and cured permanently many malignancies of the skin, especially of the basal-cell type which are local and consequently more or less benign. With the squamous-cell group and the melanomas he has not been so successful, while the expert radiologist has had real success. The radiologist claims better cosmetic results and is able to combat metastasis quite effectually, in which the surgeon is not successful. When the metastasis involves the glands of the neck, it is still an open question whether the radiologist or the surgeon has the better success. Certainly the loss of muscular function and the unyielding scar tissue, after such extensive and serious operations on the neck, together with such uncertain final results, produce a picture of convalescence which is to be avoided if possible. The successful results sometimes secured from the heavily filtered radium pack about the glands of the neck are much more pleasing. Improvement in radiation equipment and technic may raise the percentage of cures in such cases.

There is no question but that a growth in the skin itself can be removed by radium or X-ray much more surely and safely and with better cosmetic results than by surgery. In some cases, such, for instance, as those involving the cartilage of the ear or nose, and in some cases of the mouth, better results may be obtained by surgical diathermy—in which latter term we include the radio-knife. If the growth is very small, we use the radio-loop or radio-knife for immediate removal of the whole growth. In growths about the eyelid, Eller highly recommends the super-soft rays (8,000–10,000 volts). We have not had enough experience with these rays in malignant conditions to advise. In melanomas, many—but not all—of which are quite radioresistant, wide and deep removal by radio-knife, together with radium or X-ray, is indicated. Most of this work is done under local anesthesia. In that case, we believe one must be careful to use a block or modified block anesthesia and not inject the fluid into, or very close to, the lesion, for fear of carrying malignant cells into the circulation.

We have found arsenical carcinomas peculiarly resistant to radiation, and surgical diathermy may, by preference, be used in many of these cases if the growths are not too extensively distributed. The

Bowen type, while often quite resistant, usually responds to adequate radiation, as does also the extra-mammary Paget's disease.

We have had one case of adenocarcinoma of the face, of sweat-gland origin—a rare lesion—which was exceedingly radioresistant, and we believe it should have been treated by surgical diathermy at first. It had been diagnosed and operated upon in Scotland as tuberculous a few years before.

We are of the opinion that when the clinical examination and the biopsy show a highly radioresistant type of malignancy in the skin, the lesion would better be removed by surgical diathermy, but not by the cold scalpel. We believe the former method to be safer than the latter. The cells will not be distributed in the circulation or in the wound, at any rate, by a hot knife.

### RADIATION TREATMENT OF CANCER

Our knowledge of the cause and cure of cancer is still in a condition of flux, and it will probably be many years before the truth concerning the origin and elimination of this disease can be crystallized out of the heterogeneous mass of information that is now being accumulated and will continue to be accumulated in the future. The literature upon this subject during the last few years has been tremendous, and is sufficient to occupy the entire attention of anyone interested. We may be a long way from our goal, but we have gathered together a great mass of data relating to malignancy with which we must familiarize ourselves if we are going honestly and conscientiously to undertake to treat any case of cancer. No conscientious doctor, knowing what is being done to relieve the unfortunate sufferer from this dreadful disease, will lend himself to a scheme to attract patients suffering from cancer by heralding a "cure" which has been untried. It is nothing short of criminal to use one's position and money to entice suffering and dying persons to come —perhaps from long distances—for a treatment which has little or no evidence behind it to warrant its being used at all. A cure for cancer, if there ever is such a thing as a cure—it is much more likely that there will be *cures* rather than *a* cure—will not be announced out of a clear sky. It will take long and patient experimentation to develop and prove up anything that is going to be of value in the treatment of cancer. Such experimentation has been carried out with X-ray and radium in the treatment of cancer during a period of from thirty to thirty-five years. Innumerable facts of both positive and negative value have been discovered during these years, and now we can truthfully and honestly say, from extensive statistics gathered in many different clinics in different countries, that X-ray, radium, and surgical diathermy offer more hope and encouragement for cancer of the skin than any other treatment known to-day.

Rare, indeed, is the case of cancer of the skin—not too far advanced—which cannot be cured to-day by the expert with the use of X-ray, radium, or surgical diathermy. The great difficulty lies not in the fact that man cannot secure these expensive agents, but rather in his lack of knowledge and experience properly to apply them. It would seem that the time is almost here when the doctor who wishes to treat cancer and who wishes to use such agents as X-ray, radium, and diathermy, will be required to pass a special examination before being permitted to practise in that special field. The ophthalmologists require a special examination before a doctor can become a member of their scientific organization, so technical and specialized is their work regarded: surely it is not any more so than the work of the radiologist and the cancerologist.

For a number of years, statistics have shown that from 85 to 95 per cent of the cases of cancer of the skin may be cured

by X-ray or radium. Of course, those statistics are not accurate, because so much depends upon the type and grade of cancer, as well as upon the stage of its existence, as to what may be accomplished. Whether or not there are such things as pre-cancerous diseases, which may not be the proper term to use, there are certain lesions which are very closely associated with or followed by cancer, as we know it, and which, if removed early in the proper way, will, no doubt, prevent development of the disease, at least at the site of removal. If the disease, whether highly malignant or not—like a squamous-cell carcinoma or a melanoma—is treated early and by proper methods, the percentage of cures should approach close to 100 per cent.

### SO-CALLED PRE-CANCEROUS LESIONS

*Keratoses.*—These are seborrheic, senile, actinic, or arsenical in origin. If they are accompanied by any irritation of the surrounding or underlying skin, we advise their removal. We generally use X-ray or radium for this purpose—the unfiltered X-ray or the beta and gamma rays of radium. If there is a suspicion of malignancy already developing, and the lesion is less than 2 cm. in diameter, we give a hypermassive dose of unfiltered X-ray, followed by filtered X-ray, every day or two to the area about the lesion, keeping the dose up to saturation for a couple of weeks. Radium can be used similarly without enough filter to stop the beta rays. Arsenical keratoses are often highly resistant to radiation. It is better to use desiccation in these cases. Indeed, desiccation is often the agent of choice in any of the keratoses, whether or not they are becoming malignant. Especially if they have had previous insufficient radiation and have recurred, we think this might be the method of choice.

*Moles.*—We do not hesitate to advise the removal of moles when they are of the type which projects above the surface, especially when so located that they are subjected to irritation, or if they contain melanotic pigment; but we would caution against removal of such moles with the cold knife, curet, or caustic. We have seen many cases of fatal metastatic melanoma following removal of moles by excision with the knife. We have never, among thousands of cases, seen such a catastrophe follow removal of moles by thorough electrolysis, desiccation, or radio-knife or radio-loop in our own practice. We have seen one such catastrophe follow from a mole of the face which showed irritation for several weeks, but which the patient declined to have removed. Of course, we must bear in mind, as in this case, that malignancies in moles and other nevi may already be microscopically metastatic before any kind of treatment is carried out. Such metastasis may not be discovered until a later development, and perhaps we are not warranted in condemning the use of the cold knife, since in the cases we have observed metastasis might have been present before the operation. However, it is reasonable to suppose that there will be less chance of inoculating the tissue with cancer cells which we cut through with a hot needle, loop, or knife, than with cold instruments. In melanomas, it is our practice, and we believe it is good, to treat a large area about the growth removed with well-filtered X-ray or gamma ray by the saturation method. Melanomas are said to be highly resistant to these rays, a fact which we have found to be true in some, but by no means all, cases, for we have seen metastatic melanomas melt away under roentgen or gamma rays and not recur in the same locality. Therefore, we believe heavy, well-filtered radiation should be given all these melanotic cases and continued daily to saturation for three weeks. Inasmuch as these metastases are blood-borne, we doubt the efficacy of treating the drainage glands, though we often do

it as a precautionary measure. Our practice with all moles is to remove them widely and deeply with the radio-loop or radio-knife, and send the specimen to the laboratory immediately. If we suspect the mole of malignancy before we get the histologic report, or if the latter is positive, we begin radiation treatment at once. If not, we dress the wound daily till it heals, and give no radiation.

### CLASSIFICATION OF MALIGNANCIES OF THE SKIN

Malignancies of the skin may be classified as follows:

Basal-cell carcinoma or so-called rodent ulcer
Squamous-cell carcinoma
Mixed-cell carcinoma
Spinous-cell carcinoma
Adenocarcinoma
Bowen's disease
Paget's disease (extra-mammary)
Nevo-carcinoma
Xeroderma pigmentosum
Arsenical cancer
Melanoma
Spindle-cell sarcoma
Round-cell sarcoma
Kaposi's multiple pigmented hemorrhagic sarcoma

### BASAL-CELL CARCINOMA

Inasmuch as the basal-cell carcinoma does not metastasize, at least not in its early stage, it is not regarded as very malignant and is generally cured with ease by various surgical or radiological means before it becomes very extensive. The Sherwell method, *i.e.*, by curettage and application of acid nitrate of mercury, is in favor with some dermatologists. However, we must remember that basal-cell growths often arise from more than one center, that they are sometimes of mixed-cell composition, and so may be of metastatic character. Furthermore, the cosmetic results of such treatment are not so good as by radiation, and the scar tissue resulting will have diminished resistance to cancer cells. Therefore, we claim that thorough radiation of these growths is the method of choice. They may be removed intact by the radio-knife or radio-loop so that their structure is preserved for microscopic examination. Radiation treatment later would depend upon the degree of malignancy found. Their removal should be as complete as possible in the first instance, because, aside from the fact that with insufficient treatment they—as well as other types of malignancy—gain resistance to radiation after insufficient treatment, their increased growth and extension may be very destructive to important organs, especially when they are located near the orbit, the nose, or the ear. The growth may extend into the cartilages and bones, finally destroying them. Oftentimes the entire nose, with its adjoining osseous structures, or the entire orbit, with its contents, or the entire ear are thus destroyed without evidence of metastasis. Basal-cell growths occur most frequently in the face. If these growths are treated by X-ray or radium by hypermassive unfiltered doses, or by X-ray or radium followed by adequate highly filtered doses to the same area and a large area about it, such results can be prevented.

### METASTASIZING CARCINOMAS

Squamous-, mixed-, and spinous-cell carcinoma, being highly malignant, with a strong tendency to metastasize to the neighboring drainage glands, where they are inaccessible to treatment, will be considered together. They may, for practical purposes, be classed in one group. If the growth is small, it would better be widely removed by radio-knife for microscopical examination. If it is of fairly large size, a section will be sufficient. The wound should receive some electrocoagulation or desiccation in addi-

tion; then radiation should be begun. Inasmuch as these growths often metastasize very early, a large area about the growth, as well as the drainage glands, should be treated by cyto-elective radiation, *i.e.*, by highly filtered rays, at a considerable distance to get the maximum amount of energy at the required depth consistent with the toleration of the skin. This can no doubt be accomplished best with the shorter, more homogeneous wave lengths, such as we get from high voltage, highly filtered X-rays or highly filtered gamma rays. Within certain limits, at any rate, the shorter and more homogeneous the wave length, the better is the skin conserved, and the greater is the depth dose. Hence, we prefer to treat these cases with the highest voltage at present obtainable (said to be 200 K.V., but probably not more than 160 to 170 K.V. in the general run of practice, because the present American tubes will not stand up under greater strain). For this reason, we prefer radium, and follow as closely as possible the Regaud technic. We often give both X-ray and radium, as with this combination we can increase our radiation 30 per cent over what the skin would ordinarily tolerate under the action of one of these agents alone. The difficulty with X-ray is to get a sufficiently short wave length. We have in the X-ray an abundant amount of energy, but lack quality. With radium it is the reverse, so that on account of the inverse square law we must shorten our distance in order to convey into the depth as large an amount of energy as possible, but we are greatly limited here because the skin is necessarily so close to the source of radiation that it suffers disproportionately from a much smaller amount of energy than that which we convey by deep X-ray at a much greater distance, distance being a very important factor.

If we apply a pack of, say, 4 grams of radium at, say, 10 cm. distance, according to the inverse square law we should have to employ twenty-five times as much radium, namely, 100 grams, to convey the same amount of energy into the tissues if we wish to treat at 50 cm.—the usual deep X-ray therapy distance. This, of course, is not practical at the present time. When we use deep X-ray therapy we follow the Kingery law, as put into practical use by Pfahler, and keep the tissues under saturation for three weeks. If we use radium according to the Regaud method, we continue the application for from five days to two weeks, according to the amount of radium available, the depth of our dosage, and the practical distance at which we may use it. By this method we have been able to make an occasional five-year cure of metastatic squamous-cell carcinoma of the neck.

The only alternative is a block dissection of the neck, which is a serious operation, resulting in much limitation of the movements of the neck and by no means successful in curing metastatic cancer in a great majority of cases. We believe that the best success in these cases will finally come from intensive short wave therapy (at least 500 or 600 K.V.) at a considerable distance—about 50 centimeters. The primary squamous-cell growth in these cases, whether on the lip or some other part of the face, can usually be cured by the X-ray or the radium facilities we have at hand.

### BOWEN'S DISEASE

The Bowen type of carcinoma is usually quite resistant to radiation but subsides under skillful treatment with X-ray or radium, with or without surgical diathermy. The same may be said of extra-mammary Paget's disease. In the mammary Paget's we have a carcinoma of the breast to deal with and we believe pre-operative intensive and prolonged deep X-ray treatment should be given.

Sarcoma cutis of the round-cell type is more radiosensitive than that of the spindle- or mixed-cell type. These tumors should be treated by deep therapy, X-ray, or radium, and kept up to saturation for two or three weeks.

The multiple pigmented hemorrhagic sarcoma as described by Kaposi is quite radiosensitive, and should be treated by moderately high voltage X-ray, well filtered in moderate doses, repeated as development of the disease demands. Comparatively small doses will cause lesions to disappear. Care should be taken to preserve the normal skin. A permanent cure will probably not be made.

The same may be said of the lymphoblastoma group, but they require different amounts of treatment. Hodgkin's type of malignant blastoma usually requires a larger amount of radiation than the myelogenous or lymphatic leukemias. In all this group, the more homogeneous hard filtered ray is advisable.

We believe we have seen beneficial results in some of these cases from injections of from 50 to 200 microcuries of radium chloride following X-ray.

## SUMMARY

There is great need for expert specialism in radiological treatment of neoplastic diseases. Special courses and examinations should be requisite for one to practise in these specialties. Local cures of cancer of the skin by modern expert radiation management should approach closely to 100 per cent.

The great importance of biopsy for diagnostic and selective treatment purposes is emphasized. Biopsies are perhaps much more safely performed by means of the radio-knife than by the cold knife. We judge this is especially true in treating melanomas and moles.

The relative values of surgery and radiation in the treatment of malignancies of the skin are discussed, and radiation and electric surgery appear to be of greater value in the treatment of skin malignancies than surgery by the cold knife.

Modern research appears to show rather conclusively that there exists in the cancerous individual a susceptibility of certain cells under some conditions to undergo change to malignant riotry. While radiation or surgery may cure the local condition, the patient is in all probability a carrier of the cancerous tendency to later generations, and so the disease in the race may be stamped out only by breeding it out, as suggested by Slye. This would entail, however, generations of careful ante- and post-mortem examinations.

# STUDIES OF THE EFFECT OF ROENTGEN RAYS ON THE HEALING OF WOUNDS[1]

## I. THE BEHAVIOR OF SKIN WOUNDS IN RATS UNDER PRE- OR POST-OPERATIVE IRRADIATION

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THE question of the effect of roentgen rays on the healing of wounds is a problem of ever-increasing interest to both the surgeon and the radiologist. A study of the literature discloses a variance of opinion on this subject. It also reveals, however, a scarcity of carefully controlled experiments arranged so as to permit certain comparisons with clinical problems. We feel, therefore, that a discussion of a few selected articles from the recent literature should suffice.[2]

In 1928, Frey (1) exposed the extremities of dogs to filtered roentgen rays of short wave length as used in deep therapy. One group received one erythema dose every four weeks, six times; a second group received one erythema dose every six weeks, four times; a third group received one erythema dose every eight weeks, three times, and the last group received one erythema dose every twelve weeks, twice. The other extremity served as control. Four weeks following the last exposure, the animals were killed and the arteries injected with a contrast medium (minium). Roentgenograms were then taken of the entire extremity and frozen cross-sections made in order to demonstrate the blood-vessel distribution macroscopically. Groups 1 and 2 showed definite blood-vessel injuries, Group 2 less than Group 1. In Group 3 there were only slight changes, and in Group 4 no deviation from the normal could be detected. The lumen of the vessels was narrowed and their number definitely decreased. It appeared that the degree of injury was directly proportional to the total dose applied in a given period; the shorter the interval between the treatments, the greater were the pathologic changes. In another series of experiments the same author tried to determine the time required for the manifestation of the blood-vessel injuries. He exposed one kidney in dogs with 150 per cent E.D., and killed the animals one, two, and three months, respectively, following the treatment. The vessels were visualized by the injection of a contrast medium. After one- and two-month intervals, no macroscopic changes could be seen; the blood vessels of the irradiated kidney appeared to be the same as those of the untreated control. In the animals killed three months after treatment, there were also no macroscopic changes, but following injection it appeared that the number of blood vessels was definitely decreased, particularly in the medulla and the cortex. Frey concludes from these observations that within eight weeks following pre-operative roentgen therapy the surgeon should not encounter any difficulties; there should particularly not be any delay in healing. Since he did not work on wounds, however, his conclusions rest entirely on the supposition that no functional change precedes the actual morphological changes in the vessels.

More recently, Fukase (2) has approached the problem from another angle. He studied the influence of roentgen rays in moderate doses (350 r) on the healing of a simple skin wound in rabbits. From his

[1]Presented before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1–5, 1930.

[2]Bibliographies covering the older literature will be found in the papers of Frey (1).

experiments, it seemed that heavily filtered roentgen rays (170 K.V., 0.5 mm. Zn), if given in this dose over a fresh cut through the epidermis down to the cutis, decreased the inflammatory process following the trauma; in other words, the irradiated part of the wound healed more quickly than the unexposed control. Less filtered radiation (3.0 mm. Al) at the same potential had hardly any effect. The pathologic anatomical explanation is seen in the inhibitory effect of roentgen rays on leukocytes with oxyphile granules.

The fact that the researches of Frey were limited to the effect of fairly high doses of roentgen rays on the blood vessels only, and that Fukase dealt with doses below those used in malignancies, as, for instance, in pre-operative irradiation of a breast carcinoma, we decided to start a systematic

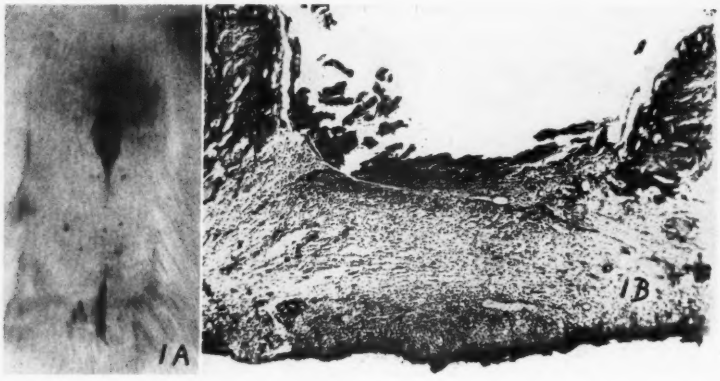


Fig. 1. Rat K 1; 100 K.V., 2.0 mm. Al, 1,000 r. One-day E-C interval. Fig. 1-*A*. Wounds seven days following the incision. Fig. 1-*B*. Photomicrogram of irradiated part of the cut.

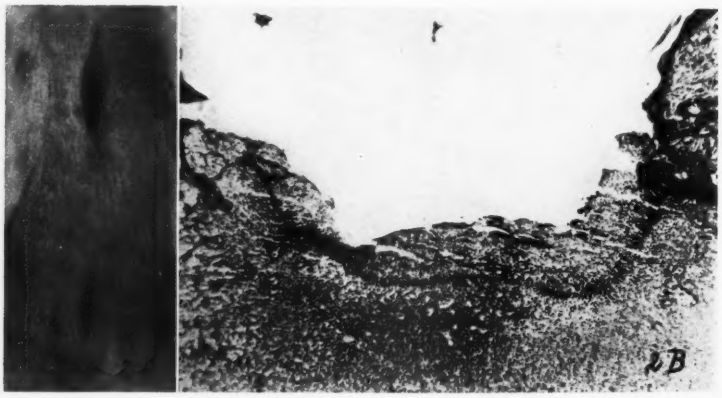


Fig. 2. Rat J 1; 100 K.V., 2.0 mm. Al, 1,000 r. Three-day E-C interval. Fig. 2-*A*. Wounds seven days following the incision. Fig. 2-*B*. Photomicrogram of irradiated part of the cut.

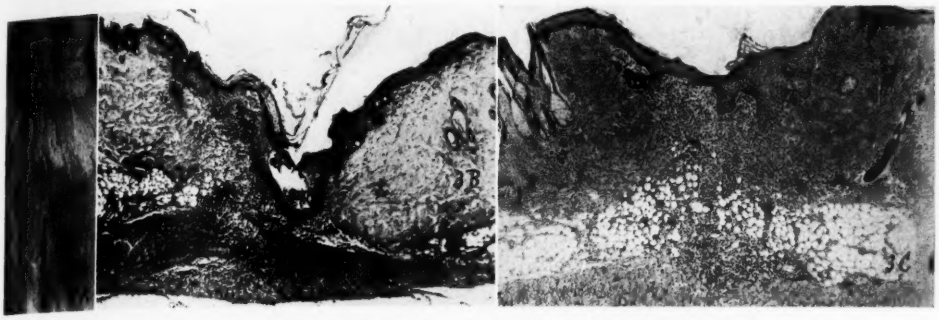

Fig. 3. Rat D 1; 100 K.V., 2.0 mm. Al, 1,000 r. Seven-day E-C interval. Fig. 3-*A*. Wounds seven days following the incision. Fig. 3-*B*. Photomicrogram of the irradiated part of the cut. Fig. 3-*C*. Photomicrogram of the unirradiated part of the cut.

study of the entire problem. Since a large number of tests seemed to be one of the most essential points in such an investigation, rats were selected for the experiments because they were most available and easily cared for. Furthermore, the toleration of their skin to roentgen rays was well known to us through previous work (3, 4). In this first paper, we have studied the behavior of dorsal skin wounds produced at certain intervals preceding exposure and also following exposure to roentgen rays.

## METHOD

Adult white rats of the same strain and free from skin lesions were kept in metal cages on a standard rat diet. Before exposure or cutting, the hair was removed from the back in an area of approximately $8 \times 2$ sq. cm., by clipping, in order to avoid the irritation of shaving. The cuts reached to the external fascia of the dorsal muscles and had an average length of 2 cm. in the case of pre-operative irradiation and of 6 cm.[3] in the rats irradiated following operation. From here on, the procedure differed in the animals treated before (First group) and after (Second group) operation.

[3]It was necessary to place one Michel clip in the center of the cut in order to prevent extensive gaping. Before cutting, the skin was painted with a 2 per cent mercurochrome solution.

In the first group, two fields of $1 \times 1.5$ sq. cm., with 2 cm. of intervening normal skin, were exposed. The cuts were made 1, 3, 7, 10, 14, 21, and 30 days, respectively, following the X-ray treatment. They left half of each irradiated area intact and extended into the neighboring skin, thus providing two test fields and two controls on each rat. Half the animals were killed seven days following the cutting; the other half as soon as the cuts had completely healed. The skin specimens were then prepared for microscopic examination.

In the second group, one field covering half of the length of the cut was exposed. The average area amounted to $1 \times 3$ square centimeters. The cuts were made immediately, 24, and 48 hours, respectively, preceding the exposure. A longer interval was not feasible because healing of the wound had progressed by the end of the third day so far as to render impossible the macroscopic evaluation of the influence of roentgen rays on the healing process. Half of the rats were killed seven days following the exposure; the remaining half on complete healing of the cuts. The skin specimens were then prepared for microscopic examination.

Two types of roentgen rays were chosen in order to study, as a secondary question, the influence of the wave length on the biological reaction: (1) 100 K.V., 2.0 mm.

Al, 20 cm. F.S.D., lambda effective 0.34 Å. (transmitted through 2.0 mm. Al), 0.7 r per second; (2) 140 K.V., 0.25 mm. Cu + 1.0 mm. Al, 45 cm. F.S.D., lambda effective 0.18 Å. (transmitted through 1.0 mm. Cu), 0.2 r per second. The apparatus used was a valve tube rectifier with condenser.

EXPERIMENTS

The macroscopic and microscopic findings will be recorded here, accompanied by a number of selected illustrations, since space does not permit the reproduction of the entire material in each group, *i.e.*, both for the same quality of radiation and for the same

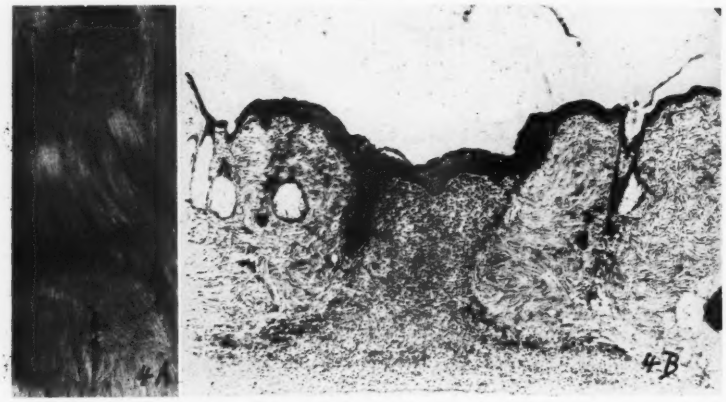


Fig. 4. Rat D 3; 100 K.V., 2.0 mm. Al, 1,000 r. Seven-day E-C interval. Fig. 4-*A*. Wounds on the fourteenth day following the incision. Fig. 4-*B*. Photomicrogram of the irradiated part of the cut.

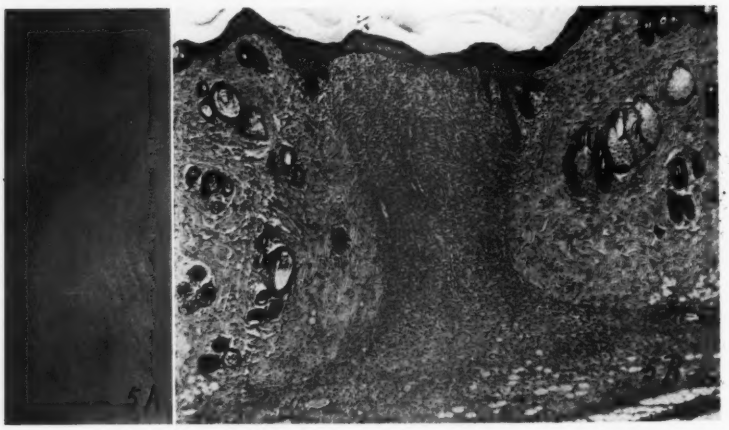


Fig. 5. Rat F 1; 100 K.V., 2.0 mm. Al, 1,000 r. Ten-day E-C interval. Fig. 5-*A*. Wounds seven days following the incision. Fig. 5-*B*. Photomicrogram of the irradiated part of the cut.

intervals between the cutting and the exposure. From two to four rats were used in each group in order to allow for individual variations. The following report is based on a total of eighty animals.

Fig. 6. Rats A 1 and B 1; 100 K.V., 2.0 mm. Al, 1,000 r. Fourteen-day E-C interval. Wounds seven days following the incision. Fig. 6-*A*. Rat A 1. Fig. 6-*B*. Rat B 1.

### I. PRE-OPERATIVE IRRADIATION

#### *(a) 100 K.V., 2.0 mm. Al, 1,000 r*

*One-day E-C*[4] *Interval.*—Macroscopically there was no essential difference between the two halves of either cut on the seventh day following the cutting (Fig. 1-*A*). *Microscopic examination:* Depressed wound not epithelialized. Crust remains. Connective tissue growth poor in progress (Fig. 1-*B*). The wounds were healed on the eighteenth day, presenting a smooth scar throughout the full length of the cut. *Microscopic examination:*[5] Epithelialized, with keratin. Scar 0.3 mm. wide. New connective tissue, with a few round cells. Beginning hyalinization.

*Three-day E-C Interval.*—No difference could be noticed on the seventh day between irradiated and non-irradiated parts (Fig. 2-*A*). *Microscopic examination:* Incision gaping; not epithelialized. Considerable crust, in which many polymorphonuclears are found. No acute reaction in tissue. New connective tissue forming (Fig. 2-*B*). The wounds were healed on the eighteenth day, without perceptible influence of the exposure. *Microscopic examination:* Scar epithelialized, with keratin. New connective tissue, with beginning hyalinization. Width 0.3 millimeter.

*Seven-day E-C Interval.*—In one rat, the cuts showed a slight advance of the healing process in the irradiated part on the seventh day, while in other animals belonging to the same group we could not detect any influence of the exposure (Fig. 3-*A*). *Micro-*

[4]This convenient abbreviation is used throughout the paper for "exposure-cutting."

[5]Unless otherwise stated, the microscopic reports refer to sections through the irradiated part of the cuts.

*scopic examination of irradiated part:* Cut epithelialized. Connective tissue not well grown. Much hyaline fibrin, many round cells (Fig. 3-*B*). *Untreated*[6] *part:* Cut completely epithelialized. The scar is conspicuous, being composed of new cellular connective tissue. The healing here is more advanced than in the irradiated part (Fig. 3-*C*). On the fourteenth day, the cuts had healed without complications (Fig. 4-*A*). *Microscopic examination:* Cut epithelialized, with keratin; 0.3 mm. average width. No hyalinization of new connective tissue (Fig. 4-*B*).

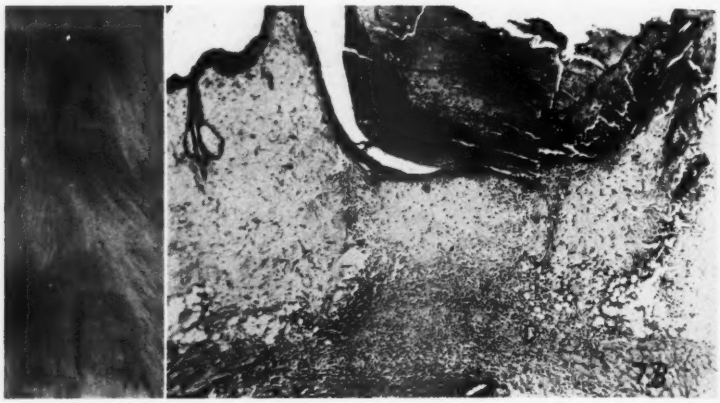

Fig. 7. Rat L 1; 100 K.V., 2.0 Al, 1,000 r. Twenty-one-day E-C interval. Fig. 7-*A*. Wounds seven days following the incision. Fig. 7-*B*. Photomicrogram of the irradiated part of the cut.

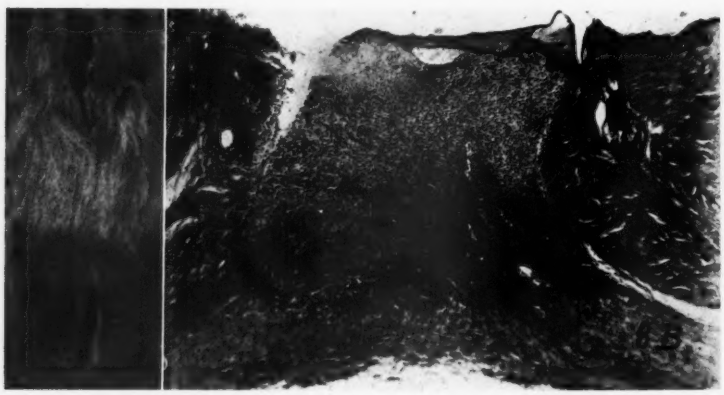

Fig. 8. Rat G 1; 100 K.V., 2.0 mm. Al, 1,000 r. Thirty-day E-C interval. Fig. 8-*A*. Wounds seven days following the incision. Fig. 8-*B*. Photomicrogram of irradiated part of the cut.

*Ten-day E-C Interval.*—On the seventh day following the cutting, the incisions were covered by crusts which had loosened in the unirradiated part. In another rat (Fig. 5-*A*), there was no difference between the

[6]The microscopic findings in the untreated parts were essentially the same as in the irradiated part except for the typical changes found in irradiated skin (See Pohle, E. A., and Bunting, C. H., *l.c.*).

irradiated and unirradiated parts of the cuts. *Microscopic examination:* Cut epithelialized; slight crust. New connective tissue with round cells. No acute reaction. Average width, 0.4 mm. (Fig. 5-*B*). On the fourteenth day, the cuts had healed. *Microscopic examination:* Scar not through muscle. Epithelialized, with keratin. Connective tissue is almost completely hyalinized.

Fig. 9. Rat H 3; 100 K.V., 2.0 mm. Al, 1,000 r. Thirty-day E-C interval. Fig. 9-*A*. Wounds on the nineteenth day following the incision. Fig. 9-*B*. Photomicrogram of irradiated part of the cut.

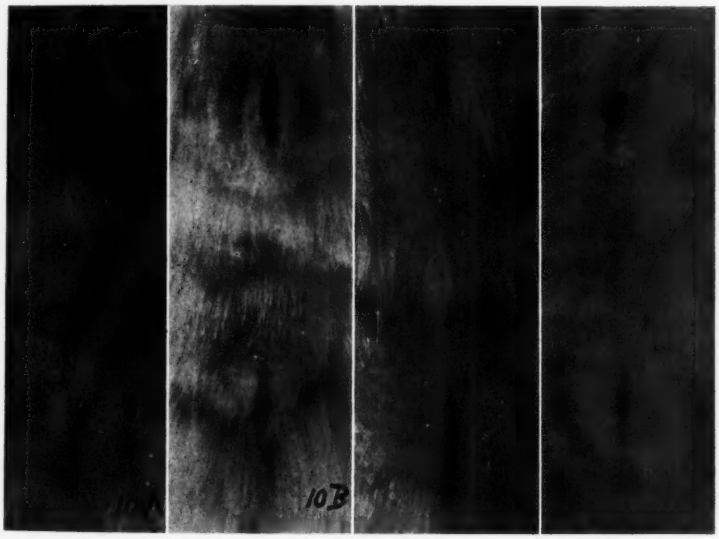


Fig. 10. Rats K 2, J 2, E 2, and F 2; 140 K.V., 0.25 mm. Cu + 1.0 mm. Al, 1,000 r. One-, 3-, 7-, and 10-day E-C intervals. Wounds seven days following the incision. Fig. 10-*A*. Rat K 2, 1-day E-C interval. Fig. 10-*B*. Rat J 2, 3-day E-C interval. Fig. 10-*C*. Rat E 2, 7-day E-C interval. Fig. 10-*D*. Rat F 2, 10-day E-C interval.

*Fourteen-day E-C Interval.*—The cuts were covered by crusts on the seventh day. These were loose in the irradiated parts in some rats (Fig. 6-*A*), but showed no difference in others (Fig. 6-*B*). *Microscopic examination:* Incisions healed and keratinized. Epithelium much thicker over wound. Between the twelfth and fourteenth day, the cuts healed uniformly. *Microscopic examination:* Completely healed and keratinized. Scar very narrow. Does not extend through muscle. Occasional polymorphonuclear.

*Twenty-one-day E-C Interval.*—On the seventh day, the healing was well under way, without noticeable difference between the treated and untreated parts of the cuts (Fig. 7-*A*). *Microscopic examination:* Considerable crust, with partial epithelialization. Poor connective tissue reaction, very edematous (Fig. 7-*B*). On the fourteenth day, the cuts had healed. *Microscopic examination:* Epithelialized, with keratin. Narrow scar. Partly hyalinized.

*Thirty-day E-C Interval.* — On the seventh day, the cuts were covered by crusts; there was more gaping of the wound than in the previously observed animals. No difference could be detected between treated and untreated parts (Fig. 8-*A*). *Microscopic examination:* Cut completely epithelialized—crust removed. Scar consists of new vascular connective tissue, with some hyalinization in the deeper layers. No acute inflammatory reaction present (Fig. 8-*B*). On the nineteenth day, the wounds were well healed without macroscopic changes in the irradiated parts of the cuts (Fig. 9-*A*). *Microscopic examination:* Fully epithelialized, with keratin. Upper part of connective tissue is partly hyalinized. Considerable round-cell reaction in the deeper layer. A few foreign body giant cells around hairs (Fig. 9-*B*).

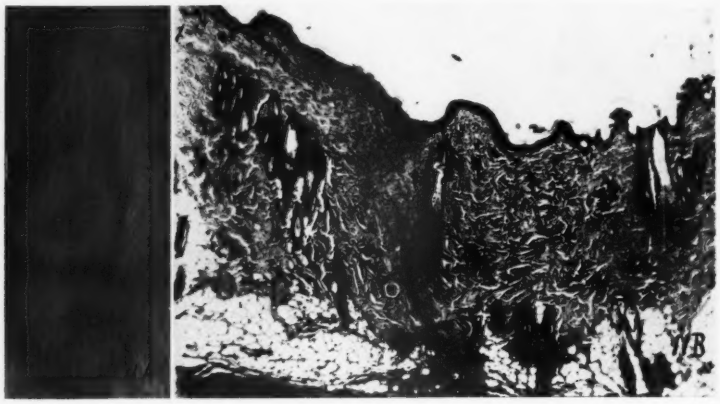

Fig. 11. Rat A 2; 140 K.V., 0.25 mm. Cu + 1.0 mm. Al, 1,000 r. Fourteen-day E-C interval. Fig. 11-*A*. Wounds seven days following the incision. Fig. 11-*B*. Photomicrogram of irradiated part of the cut.

*(b) 140 K.V., 0.25 mm. Cu +1.0 mm. Al, 1,000 r*

In this group, the results did not differ in any characteristic manner from those observed in the rats exposed to the radiation of longer wave length. We confine the report, therefore, to the presentation of a few selected photographs and photomicrograms

demonstrating this fact. They were all taken seven days following the cutting.

*One-day E-C Interval.—Microscopic examination:* Epithelialized, with keratin. Width 0.3 mm. average. New connective tissue, with a few round cells (Fig. 10-*A*).

*Three-day E-C Interval.—Microscopic examination:* Not epithelialized; crust remains. Considerable fibrin in new connective tissue; 1.0 mm. wide (Fig. 10-*B*).

*Seven-day E-C Interval. — Microscopic examination:* Cut partially epithelialized, with crust. Considerable fibrin and serum remains in deeper layers. No acute reaction (Fig. 10-*C*).

*Ten-day E-C Interval.—Microscopic examination:* Cut epithelialized, with keratin. Scar very narrow and almost completely hyalinized (Fig. 10-*D*).

*Fourteen-day E-C Interval.—Microscopic examination:* Scar epithelialized, with keratin, very narrow (Fig. 11).

*Twenty-one-day E-C Interval.—Microscopic examination:* Almost epithelialized. Considerable crust remains. No acute reaction. New connective tissue, considerable edema, and many round cells (Fig. 12-*A*).

*Thirty-day E-C Interval.—Microscopic examination:* Epithelialized. Crust remains. Some acute reaction in upper layers. Considerable fibrin in deeper part (Fig. 12-*B*).

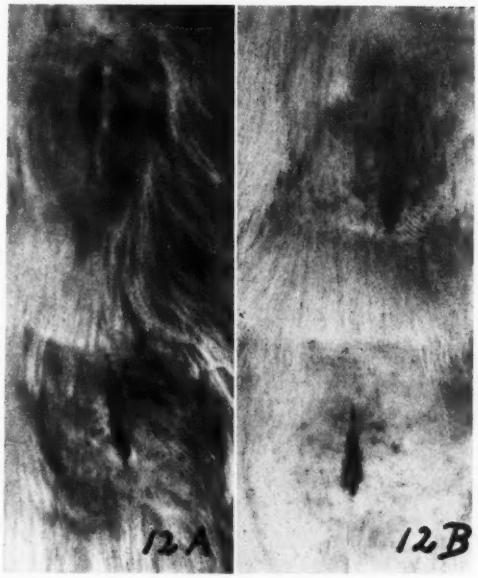


Fig. 12. Rats M 2, H 2; 140 K.V., 0.25 mm. Cu + 1.0 mm. Al, 1,000 r. Twenty-one- and thirty-day E-C intervals, respectively. Wounds seven days following the incision. Fig. 12-*A*. Rat M 2, twenty-one-day E-C interval. Fig. 12-*B*. Rat H 2, thirty-day E-C interval.

### II. POST-OPERATIVE IRRADIATION

#### *(a) 100 K.V., 2.0 mm. Al, 1,000 r*

*Exposure immediately after cutting.*—Seven days after the cutting, there was a slight retardation of the healing of the irradiated part in one rat, while the others

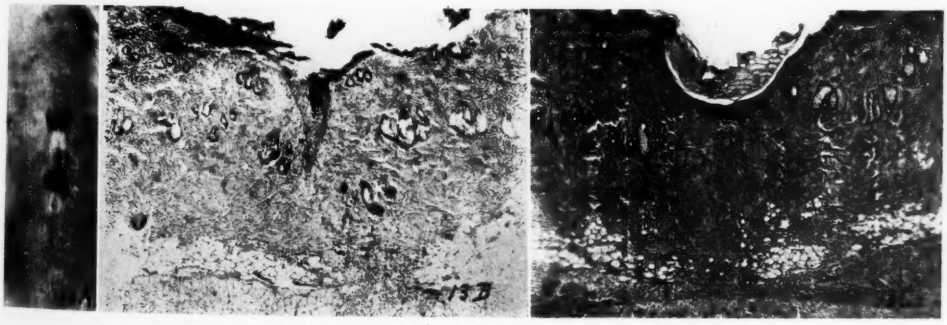

Fig. 13. Rat X 5, 100 K.V., 2.0 mm. Al, 1,000 r. Exposure immediately after cutting. Fig. 13-*A*. Wound seven days following the incision. Fig. 13-*B*. Photomicrogram of irradiated part. Fig. 13-*C*. Photomicrogram of untreated part.

did not show any difference (Fig. 13-*A*). *Microscopic examination of irradiated part:* Epithelialized, with keratin. Very narrow scar, with complete hyalinization (Fig. 13-*B*). *Untreated part:* Completely epithelialized. A slight crust remains. The scar is definite and is not hyalinized. It consists of new capillaries and cellular connective tissue. No essential difference between this and the irradiated part (Fig. 13-*C*). On the twenty-second day, the entire cut was well healed, without any macroscopic influence of the exposure (Fig. 14-*A*). *Microscopic examination:* Epithelialized, with keratin. Connective tissue forms scar 0.15 mm. wide. Almost entirely hyalinized (Fig. 14-*B*).

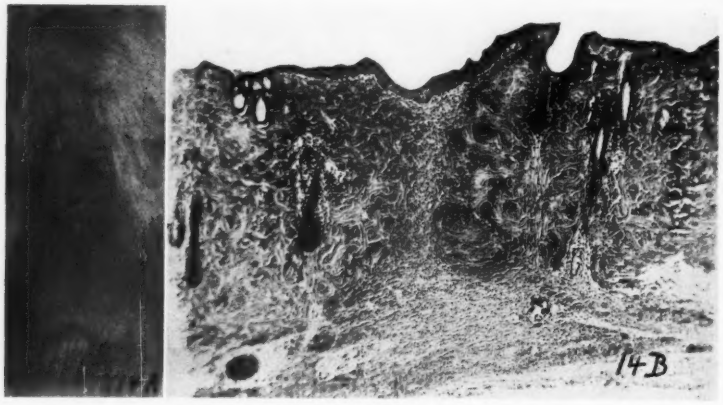


Fig. 14. Rat X 3, 100 K.V., 2.0 mm. Al, 1,000 r. Exposure immediately after cutting. Fig. 14-*A*. Wound on twenty-second day following the incision. Fig. 14-*B*. Photomicrogram of irradiated part.

*Twenty-four-hour C-E Interval.*—Seven days after the cutting and six days following the exposure, the healing process in the untreated half of the cut in all rats in this group was definitely more advanced (Fig. 15-*A*). *Microscopic examination of irradiated part:* Epithelialization only partial. Crust remains. Poor connective tissue reaction, with considerable edema in cut (Fig. 15-*B*). *Untreated part:* Fully epithelialized except where slight crust remains, to one side of incision. Scar is very narrow in the upper layers, but in the deeper layer it spreads and there is hyaline fibrin present. Many phagocytes and lymphocytes are still present. Healing in this part is greatly advanced in comparison with the irradiated part (Fig. 15-*C*). On the twentieth day after cutting, the wounds were completely healed, without macroscopic difference between exposed and unexposed halves (Fig. 16-*A*). *Microscopic examination of irradiated part:* Epithelialized, with keratin. Connective tissue partially hyalinized; 0.15 mm., average width. Mononuclear reaction in deeper layers (Fig. 16-*B*). *Untreated part:* Epithelialized perfectly. New connective tissue is present just under the epithelium; the rest of the scar is almost fully hyalinized. Healing here is very slightly more advanced than in the irradiated portion (Fig. 16-*C*).

*Forty-eight-hour C-E Interval.*—On the seventh day, the untreated parts of the cuts had almost healed, while the upper irradiated parts were still covered by crusts (Fig. 17-*A*). *Microscopic examination:* Crust remains; not completely epithelialized. In underlying tissue considerable fibrin re-

mains, with round cells (Fig. 17-*B*). On the fifteenth day, the wounds had healed completely. There was no macroscopic difference between the treated and untreated parts. *Microscopic examination:* Except for down-dipping of epithelium and defect in muscle, scar could not be found.

*(b) 140 K.V., 0.25 mm. Cu + 1.0 mm. Al, 1,000 r*

As in the group with pre-operative irradiation, no definite influence of the wave length could be detected in the behavior of the cuts. The accompanying photographs and photomicrograms demonstrate this observation.

*Exposure immediately after cutting.*—Figure 18-*A* shows the wound seven days after the cutting. *Microscopic examination:* Though epithelialization is complete, a slight crust remains. The scar is thin, the connective tissue growth complete.

*Twenty-four-hour C-E Interval.*—Figure 19-*A* shows the wound seven days after the incision. *Microscopic examination:* The cut is completely epithelialized. New connective tissue, no hyalinization. "Dead space" present (Fig. 19-*B*).

*Forty-eight-hour C-E Interval.*—Figure 18-*B* shows the wound seven days after the incision. *Microscopic examination:* Epithelium torn (crust present). New connective tissue in scar, without hyalinization. Control shows complete growth of epithelium and thin scar, which is in great part hyalinized. Figure 20-*A* shows the wound healed on the twentieth day following the incision. *Microscopic examination of irradiated part:* Cut epithelialized, with keratin. Connective tissue almost completely hyalinized. Width 0.2 mm. (Fig. 20-*B*). *Untreated part:* Epithelialized perfectly. The scar is very inconspicuous, being represented by only a slightly increased cellularity of the connective tissue, except in the deeper layers, where a small amount of new cellular connective tissue is present. Healing here is slightly in advance of that in the irradiated tissue (Fig. 20-*C*).

## DISCUSSION OF RESULTS

Before entering into the analysis of the experimental data reported above several points deserve our consideration. In the evaluation of the results we must not forget that our work was carried out on healthy animals and it is quite possible that persons who are ill would react differently. Furthermore, the dosage represents an important factor. The amount of exposure used

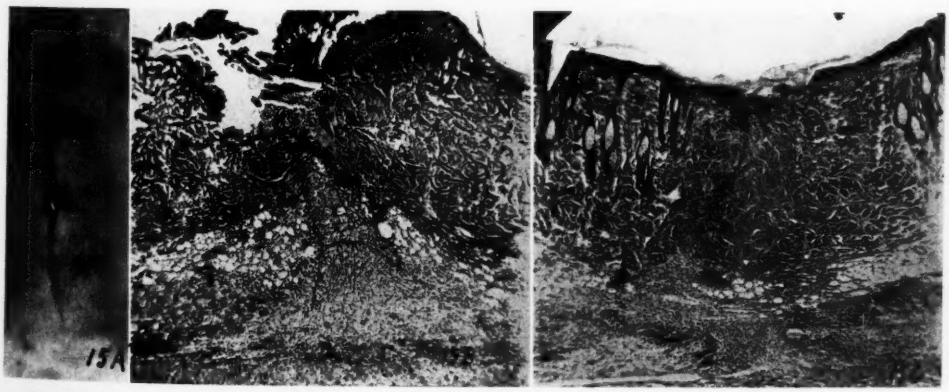


Fig. 15. Rat X 7, 100 K.V., 2.0 mm. Al, 1,000 r. Twenty-four-hour C-E interval. Fig. 15-*A*. Wound seven days following the incision. Fig. 15-*B*. Photomicrogram of irradiated part. Fig. 15-*C*. Photomicrogram of untreated part.

in our animals did not produce skin reactions of the second or third degree. It was chosen because we knew from tests performed previously that, beginning at about 1,300 r, definite ulceration occurs in the skin of rats. One should logically expect an interference with the healing process of wounds in such an injured skin area. The cuts did not sever the muscle nor were the wounds sutured. With these facts in mind our material will be analyzed.

In the first group, in which the incisions were made in irradiated areas at intervals of from one to thirty days following exposure, it appeared both from the macroscopic and microscopic examinations that there was no definite evidence of retarded healing. The changes due to irradiation, as, for instance, thickening of the capillary walls, mitotic figures in the malpighian layer, and fibroblasts in the corium, have not been mentioned in each case since they repeated themselves throughout the sections. The dose used for both wave lengths corresponded to a threshold erythema for rat's skin, determined and controlled on more than one hundred animals. No effect of the wave length could be detected in any of the tests. If it is permissible to draw any comparisons with our clinical problems, we may assume that moderate roentgen-ray exposure from one to thirty days preceding the operation will not interfere with the healing process in the skin following operation.

In the second group, representing postoperative irradiation, a definite retardation of the healing in the irradiated part of the incision was noticeable. The macroscopic as well as the microscopic studies brought out the fact that exposure twenty-four hours following the incision seemed to have the most pronounced inhibitive effect. After the incisions had completely healed, there appeared to be no difference between the exposed and unexposed parts of the scars. The total healing time varied from 15 to 22 days; in untreated rats, healing usually occurred within from 12 to 15 days. However, we do not wish to place too much value on this time interval. Towards the end of the healing period, it is quite difficult to reach a decision as to the exact date of the healing. Individual observers might easily disagree, since, for instance, a small piece of crust may remain attached for several days in one rat, while in another animal it may sooner become loose, either spontaneously or accidentally. This was most strikingly demonstrated in the first group, in which two cuts on the same rat had been made. Quite often one of these cuts presented a perfect scar from three to four days before the other cut had reached the same stage. Our conclusions rest, there-

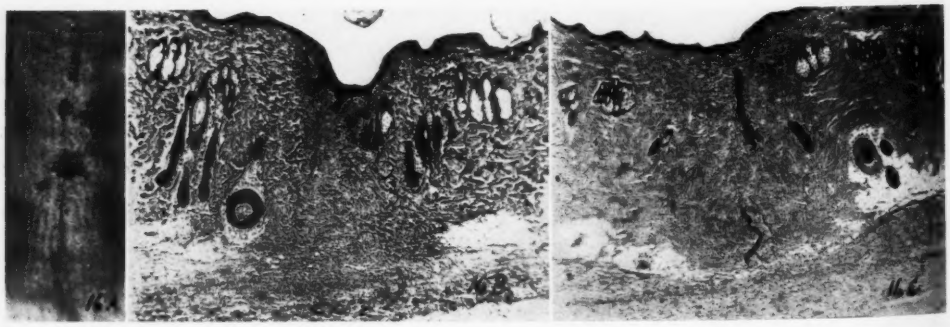

Fig. 16. Rat X 12, 100 K.V., 2.0 mm. Al, 1,000 r. Twenty-four-hour C-E interval. Fig. 16-*A*. Wound on twentieth day following incision. Fig. 16-*B*. Photomicrogram of irradiated part. Fig. 16-*C*. Photomicrogram of untreated part.

fore, mostly on the comparisons made on the seventh day. They lead us to believe that if retardation of the healing of the incision is judged to be undesirable, post-operative exposure of surgical wounds should be carried out after the scar has been formed. This applies, of course, only to doses of roentgen rays as used in our experiments. However, should the immediate irradiation of the wound be deemed essential, the results of our experiments seem to indicate that a satisfactory scar formation can be expected, provided, again, that no excessive doses of radiant energy are administered. This deduction is borne out by clinical observations. Halberstaedter and Simons (5) found that wounds irradiated after operation showed delayed healing. The final scars were, however, more satisfactory than in the untreated cases. If one-half of an incision following the removal of a malignant tumor had been irradiated, it was noted in one patient that a recurrence appeared in the unexposed half only. According to Hintze (6), the delay is less pronounced if the tissue defect has been made by the electric cautery as compared with the ordinary knife. The same observation was reported by Schürch and Tschudi (7), who used, however, radium alone, while Hintze employed both X-rays and radium. The

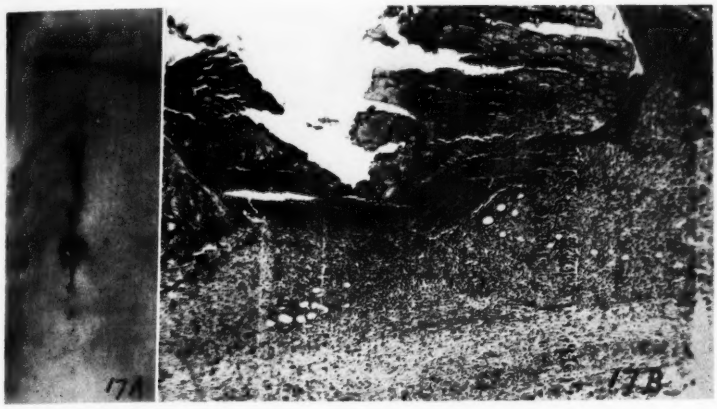

Fig. 17. Rat X 9, 100 K.V., 2.0 mm. Al, 1,000 r. Forty-eight-hour C-E interval. Fig. 17-*A*. Wound seven days following incision. Fig. 17-*B*. Photomicrogram of irradiated part.

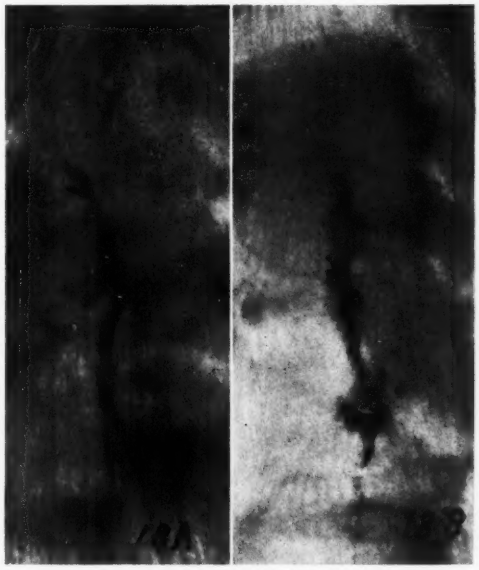

Fig. 18. Rats X 6 and X 10, 140 K.V., 0.25 mm. Cu + 1.0 mm. Al, 1,000 r. Fig. 18-*A*. Rat X 6, exposure immediately after cutting. Wound seven days after the incision. Fig. 18-*B*. Rat X 10, forty-eight-hour C-E interval. Wound seven days after incision.

rôle of the reticulo-endothelial system in the healing process has also been emphasized (8); it is manifested shortly after the trauma. No attempt has been made in the work reported here to investigate the mechanism of the retarding effect of roentgen rays on the healing of the skin incisions.

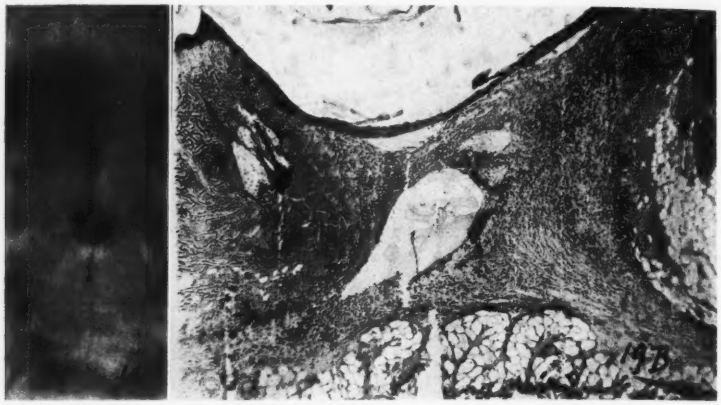

Fig. 19. Rat X 8, 140 K.V., 0.25 mm. Cu + 1.0 mm. Al, 1,000 r. Twenty-four-hour C-E interval. Fig. 19-*A*. Wound seven days following incision. Fig. 19-*B*. Photomicrogram of irradiated part.

## SUMMARY

1. Eighty white rats were exposed to two qualities of roentgen rays (100 K.V., 2.0 mm. Al; 140 K.V., 0.25 mm. Cu + 1.0 mm. Al) preceding or following incisions in the skin. In the first group, half of each wound extended into previously irradiated skin; the other half remained in unexposed tissue. In the second group, half of each incision was irradiated following the cutting and the other half was protected. Seven days following the cutting and also after complete healing, the animals were killed and the skin prepared for microscopic examination.

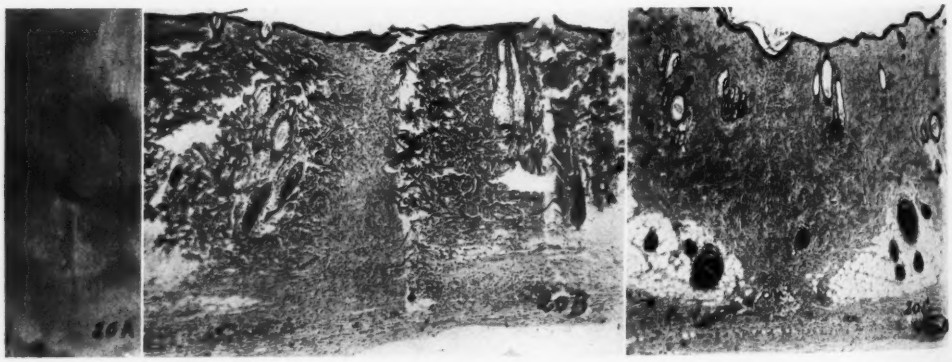

Fig. 20. Rat X 18, 140 K.V., 0.25 mm. Cu + 1.0 mm. Al, 1,000 r. Forty-eight-hour C-E interval. Fig. 20-*A*. Wound on twentieth day following incision. Fig. 20-*B*. Photomicrogram of irradiated part. Fig. 20-*C*. Photomicrogram of untreated part.

2. Irradiation with a dose of 1,000 r given in one sitting, of either quality of roentgen rays, as defined above, from one to thirty days before the incision, did not influence the healing process perceptibly.

3. Irradiation with a dose of 1,000 r in one sitting, with either quality of roentgen rays, as defined above, immediately, twenty-four hours, and forty-eight hours, respectively, after the incisions, retarded the healing process, particularly in the twenty-four-hour group, but did not interfere with the final formation of a smooth scar.

## BIBLIOGRAPHY

(1) Frey, Sigurd: Bruns' Beitr. z. klin. Chir., 1928, CXLIV, 574.
Idem: Deutsche Ztschr. f. Chir., 1928, CCXII, 325.

(2) Fukase, Shuichi: Virchow's Archiv, 1929, CCLXXIII, 794.
Idem: Strahlentherapie, 1930, XXXVI, 95, 102.

(3) Pohle, E. A., and Bunting, C. H.: Radiology, December, 1929, XIII, 496.
Idem: Radiology, December, 1930, XV, 647.

(4) Pohle, Ernst A., and Wright, Cecil S.: Radiology, April, 1930, XIV, 351.

(5) Halberstaedter, L., and Simons, Alb.: Acta Radiologica, 1926, V, 501.

(6) Hintze, A.: Fortschr. a. d. Geb. d. Röntgenstr., 1929, XL, 93 (Kongressheft).

(7) Schürch, O., and Tschudi, E.: Strahlentherapie, 1929, XXXII, 143.

(8) Cazzamali, P.: Clinica chir., 1927, III, 986.
Idem: Clinica chir., 1928, IV, 781.

## DISCUSSION

Dr. Henry Schmitz (Chicago): I am very much interested in this work. I wish to recall the observations I made in carcinomas of the breast. In carcinomas of the breast, pre-operative radiation has been advised, and for many years this was done at our clinic. Finally we had to stop for the reason that necrosis of the skin was very frequent following irradiation and healing would be postponed for a relatively long period. We finally concluded that the pre-operative irradiation of carcinomas of the breast was not advisable, due to the long morbidity it produced. Should a patient enter the clinic with a Group 3 carcinoma, that is an involvement of the superior axillary lymph nodes or ulceration of the skin, then irradiation is given, using a combined radium and X-ray technic, with the intention of applying 2 to 2.5 of an erythema dose. If within six to eight weeks the skin has healed and the breast and axillary lymph nodes have become freely movable, then operation is advised.

Why the experimental observations reported by Pohle *et al.* should differ from clinical observations it is impossible for me to state, except that we are working, first, with pathological tissue changes, and secondly, with a person who is ill. Whether these facts have any bearing on the end-results or whether the radiation dose applied is of much greater intensity in comparison with the tolerance of the rat skin, are points which should be subjected to research.

Dr. Pohle (closing): This paper has certainly brought out a very interesting discussion of a problem important to all of us. I wish to say, however, that our work was purely experimental, and of course we did not attempt to decide the question as to the value of pre- and post-operative irradiation in cancer of the breast. Insofar as the transferring of the results of animal experiments to clinical problems is concerned, I believe that is very much a matter of personal judgment. If we look back, though, in the history of medicine, we find that animal experiments have helped us considerably many times.

Concerning the discrepancy in the results, at least in the animals irradiated before operation, I feel that it is easily explainable by the dosage. This is further borne out by the fact that clinical experiences do not agree, and probably for the same reason. Dr. Schmitz, for instance, has seen a definite retardation in the healing of the breast

incision, so that he has almost given up pre- and post-operative irradiation in these cases. Other observers, for example, Dr. Ullmann, with a dose of 800, and another discussant, with 1,000 r applied over the breast, did not see any retardation at all. I think the best solution of this problem will be to use the results of experimental work with discretion, and proceed then along lines of clinical investigation.

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**Principles of Prognosis in Cancer. William C. MacCarty. Jour. Am. Med. Assn., Jan. 3, 1931, XCVI, 30.**

It is a mistake, with present knowledge, to use any one criterion as the basis of clinical prognosis in cancer. It is perfectly legitimate and proper to attempt grading. Clinical and pathologic experience show at least fifteen factors governing prognosis in cancer. They are as follows:

(1) Length of life is inversely proportional to the amount of glandular involvement and distant metastasis.

(2) The greater the fixation of a cancer to surrounding structures the greater the difficulty of surgical removal, the greater the immediate operative risk, and the less the chance for complete recovery.

(3) Malignant or benign tumors so located as to produce early pain, hemorrhage, mechanical obstruction, or an easily recognizable mass are more favorable.

(4 and 5) The lower the cardiac and renal efficiency, the poorer the prognosis, and especially the greater the immediate therapeutic risk.

(6) Anemia is associated apparently with two conditions: reduction of diet; hemorrhage, either single or constant or repeated oozing from the growth. Perhaps a third condition exists, namely, an anemia due to a theoretical toxic condition from the cancer itself or associated with its disintegration. The greater the anemia, the greater the immediate therapeutic risk and the shorter the length of life. That of a single or a recent repeated hemorrhage from the growth may not necessarily alter the ultimate prognosis after the growth is removed.

(7) It has been established that there is a definite relation between the size and the presence of glandular involvement which, in turn, has prognostic value. The larger the primary growth, the greater the possibility of glandular involvement and hence the worse the prognosis.

(8) Generalizations regarding age alone, when applied to clinical practice, might sometimes be very misleading. It is perhaps correct to say, the younger the patient the worse the prognosis, keeping always in mind that all other factors have an influence regardless of age.

(9) Direction of growth, whether the bulk of the cancerous mass is toward the lumen or surface of the organ or whether it is infiltrating the wall and growing toward adjacent organs or vital cavities is a factor. The latter has the worse prognosis.

(10) As a single prognostic factor, loss of weight is probably of little significance, but taken in association with some or all of the other factors it adds gravity to any prognosis.

(11, 12, 13, and 14) There can be no doubt but that there is some relation between the degree of differentiation of tumor cells and their rate of growth; but size, location, infiltration, glandular involvement and fixation, lymphocytic infiltration, fibrosis, and hyalinization must all be taken into consideration.

(15) In general, the duration of the disease is mainly of value when taken in conjunction with other factors.

CHARLES G. SUTHERLAND, M.D.

# THE TECHNIC OF RADIOGRAPHY BY GAMMA RAYS*

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GAMMA rays can be used in place of X-rays as a means of non-destructive testing of castings and welds for internal defects. It was shown by Mehl, Doan, and Barrett[1] that radiographs can be taken through ordinary sections of steel in a few hours, using as sources of $\gamma$-rays amounts of radium readily available at hospitals in the larger cities. The greater penetrating power of $\gamma$-rays compared with X-rays was pointed out, and examples reproduced of radiographs taken through thicknesses well beyond the range of usefulness of X-rays at present available.

The apparatus necessary for $\gamma$-ray radiography is very simple. A small container of radio-active material is supported rigidly in front of the specimen to be inspected, and X-ray films in suitable holders fastened to the back of the specimens.

Figure 1 shows the experimental arrangement used for taking four simultaneous radiographs of specimens built up of plates. A small glass funnel was used to hold the bulb of radium emanation in the center of the group. In Figure 2 a similar funnel is hung on strings in front of an arm of a forge press, and a film is placed behind it, without removal of the piece. Figure 3 shows the method that was used to explore a large cylindrical casting. Here the source of $\gamma$-rays was mounted on a stand within the casting, and films were fastened opposite the source, on the outside. It would have been possible to take radiographs simultaneously on a belt of films extending completely around this casting had it been desired. One of the operators is shown holding a lead-lined box containing a bulb of radium emanation eight inches in diameter.

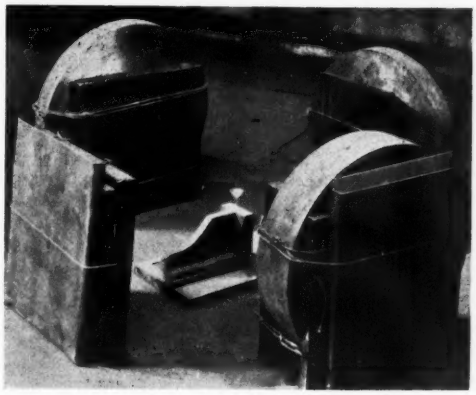


Fig. 1. Arrangement used to radiograph experimental specimens. (Cf. Figs. 4 and 5.)

The characteristics of the $\gamma$-ray method make it especially applicable to radiographic work through thicknesses above 2 or 3 inches of iron such as are found, for instance, with castings for high pressure steam power plants. When portability is necessary the method is again very appropriate, since no high voltage electrical apparatus is required. A lead-lined room is unnecessary, as the operator's simplest protection from the rays is merely to remain at a distance from the radium during the exposure, and to handle the radium with forceps.

It was the purpose of the previous paper to demonstrate the possibility of $\gamma$-ray radiography by exhibiting actual radiographs through a large range of thicknesses of steel, and by theoretical arguments. Such interest has been shown in this possibility, especially among the makers and users of large castings, that a definite technic for taking suitable radiographs is already in de-

*Published with the permission of the Navy Department. Reprinted by permission from *Metals and Alloys*, December, 1930, I, No. 18, p. 872.

[1]Radiography by the Use of Gamma Rays. Trans. Am. Soc. for Steel Treating, Reprint, Chicago, 1930.

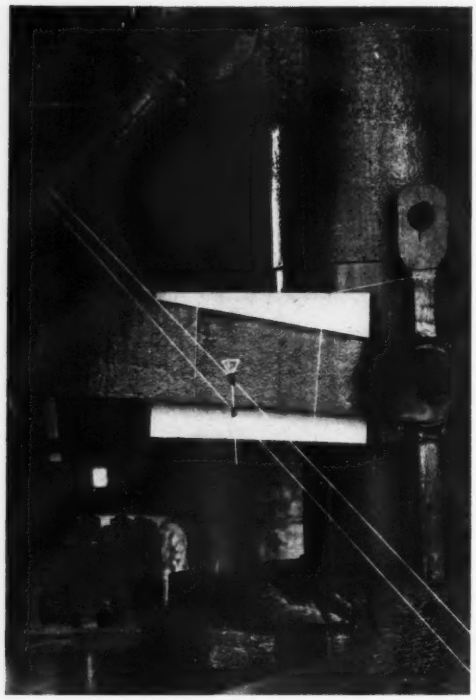


Fig. 2. Glass funnel, supported by strings, holds radium in front of an arm of a forge press for radiographic inspection *in situ*.

mand. From the cost standpoint, the importance of eliminating guesswork is obvious. Radium is not so cheap that its use can be a success in practice if any considerable percentage of radiographs taken with it are failures, or if advantage is not taken of means of increasing the efficiency of the process.

The present paper is an attempt to give definite recommendations and quantitative data for taking γ-ray radiographs. It seems advisable to discuss the physics involved in the technic in some detail; this is done under the headings, "The Source of Gamma Rays," "The Effect of Rays on Films," "Exposures Necessary," and "Scattering of Gamma Rays." In view of the simplicity of both apparatus and operations involved in γ-ray inspection, highly skilled labor seems unnecessary. A simple presentation of a suitable technic is, therefore, in order, and while it may be lacking under the headings mentioned, the division "Operations in Practice" is intended to fill this need.

The difficulty of reproducing radiographs for publication is well known. A tremendous range of densities may be satisfactorily recorded on a film, but only a few appear on a print. To illustrate points in the discussion below, however, it is necessary to reproduce some actual radiographs regardless of the quality of the reproduction. This has been attempted in Figures 4 to 9, through photography of the original films placed on a viewing frame and illuminated by diffuse light from the rear. In some cases increased contrast has been obtained through the use of Process film and contrast printing; in other cases it was necessary to reduce contrast and suffer a corresponding loss of detail. No retouching has been done.

## THE SOURCE OF GAMMA RAYS

The only radio-active material of practical importance seems to be radium; there are considerable amounts[2] of this distributed in several cities in the United States and used for medical purposes.

Radium decomposes at a constant rate into the gas radium emanation, which, in turn, produces a series of decomposing solids, some of which give off γ-rays.[3] The strength of these rays is proportional to the amount of radium emanation present. If the emanation is left in contact with the radium from which it forms, it builds up until equilibrium is reached, when its rate of formation equals its rate of decay, and its strength is then proportional to the amount of the radium. The amount of emanation in equilibrium with one gram of radium, as

[2]Figures do not seem to be available as to the amount of radium in the country. No radium has been produced in this country since 1925, but the U. S. Department of Commerce has estimated that 45 or 50 grams were imported during the years 1924–1929, and we understand it is being imported at an increasing rate.

[3]Practically all the gamma rays effective in radiographic work arise from the disintegration of Radium C.

measured by the intensity of the γ-rays emitted, is called a curie.

Radium emanation may be pumped from the parent radium, and sealed in small glass bulbs. In this form its strength decreases so that the intensity I of X-rays at any moment is $I = I_o e^{-\lambda t}$, where t is the time interval that has elapsed since the intensity was $I_o$, and λ is a constant, equal to 0.007551, when t is measured in hours. Table I gives values hourly for $\frac{I}{I_o}$.

Either radium or radium emanation may be used for radiography, but the necessary exposure times are different. When radium is used one has a source of a constant intensity, and the exposure obtained is proportional to the product of intensity and time, $I_o t$. With emanation as a source the exposure is proportional to the integral of intensity with respect to time, *i.e.*,

$$\int_0^t I\,dt = I_o \int_0^t e^{-\lambda t}\,dt = \frac{I_o}{\lambda}(1 - e^{-\lambda t}).$$

With the use of this formula Table II has been computed, giving the number of hours' exposure necessary with emanation to produce a result equal to a given number of hours' exposure with radium, when the strength of the emanation in millicuries at the beginning of the exposure is equal to the number of milligrams of radium. For example, if one desired exposure of 1,200 milligram-hours, it could be had with 100 milligrams of radium in 12 hours, 200 milligrams in 6 hours, etc.; but reference to Table II shows that if one started with 100 millicuries of emanation it would require 12.6 hours, or, starting with 200 millicuries, 6.1 hours would be necessary.

A less accurate method of calculating exposures is to assume that the decay is linear with time and that the mean strength of the emanation during an exposure is simply the average of the initial and final strengths. The errors in such calculations are negligible in practice unless exposures are many hours long.

Fig. 3. Radiographing a large cylindrical casting. Radium is held on a stand inside and films are fastened outside. (Cf. Fig. 9.)

TABLE I.—DECAY OF RADIUM EMANATION*

(for λ = 0.007551 hrs.; half life = 3.825 days)

| Time t | Intensity $e^{-\lambda t}$ | Time t | Intensity $e^{-\lambda t}$ | Time t | Intensity $e^{-\lambda t}$ | Time t | Intensity $e^{-\lambda t}$ |
|---|---|---|---|---|---|---|---|
| 0 | 1.0000 | | | | | | |
| 1 | 0.9925 | 13 | 0.9064 | 25 | 0.8278 | 37 | 0.7560 |
| 2 | 0.9850 | 14 | 0.8996 | 26 | 0.8216 | 38 | 0.7504 |
| 3 | 0.9786 | 15 | 0.8929 | 27 | 0.8155 | 39 | 0.7448 |
| 4 | 0.9703 | 16 | 0.8861 | 28 | 0.8093 | 40 | 0.7391 |
| 5 | 0.9629 | 17 | 0.8795 | 29 | 0.8032 | 41 | 0.7336 |
| 6 | 0.9557 | 18 | 0.8729 | 30 | 0.7973 | 42 | 0.7282 |
| 7 | 0.9485 | 19 | 0.8662 | 31 | 0.7911 | 43 | 0.7225 |
| 8 | 0.9413 | 20 | 0.8597 | 32 | 0.7852 | 44 | 0.7171 |
| 9 | 0.9343 | 21 | 0.8533 | 33 | 0.7793 | 45 | 0.7117 |
| 10 | 0.9272 | 22 | 0.8468 | 34 | 0.7734 | 46 | 0.7064 |
| 11 | 0.9203 | 23 | 0.8405 | 35 | 0.7676 | 47 | 0.7010 |
| 12 | 0.9134 | 24 | 0.8343 | 36 | 0.7620 | 48 | 0.6960 |

*Meyer-Schweidler, "Radioactivität," Teubener, Berlin (1927), page 419.

## EFFECT OF RAYS ON FILMS

In both X-ray and γ-ray work where but a minute fraction of the radiation passing through a film is absorbed by the emulsion, any method of increasing the photographic effect of the rays is of great practical importance. Eastman Superspeed Duplitized X-ray films, with their large grain size and double emulsion are very fast. Overdevelopment further increases their speed. Satisfactory development technic consists of

developing in the standard Eastman X-ray Developer to which 20 milligrams of potassium iodide per liter have been added, for twice the length of time recommended for ordinary X-ray work at the various temperatures.[4] For example, at 65° F. development may be prolonged to ten minutes, the potassium iodide preventing excessive fog. This technic was used throughout the work reported in this paper.

Secondary electrons ejected by the γ-rays are more completely absorbed in the emulsion than the γ-rays themselves, so that a copious emitter of secondary electrons in contact with the emulsion can considerably increase the efficiency of the film. Lead foil[5] placed on both sides of the film was found to shorten the exposure times for γ-rays as it is commonly known to do for X-rays.

Fig. 4. Radiograph of slotted steel plate arranged as shown in Figure 1. Total thickness, 4 inches; distance, source to film, 18 inches; exposure, 3,050 milligram-hours, using three lead intensifying screens with two films. Dimensions of slots as follows, from left to right:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Width in mm. | 13 | 6 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 |
| Depth in mm. | 13 | 13 | 2 | 3 | 6 | 12 | 2 | 3.5 | 6.5 | 12 | 2 |

[4] A chart of standard developing times is given in "X-rays in Industry," Eastman Kodak Co., 1929.

[5] The foil used was General Electric X-ray Corporation's "X-ray Foil," 0.006-inch thick.

TABLE II.—COMPARISON OF EXPOSURE TIMES IN HOURS FOR RADIUM AND FOR RADIUM EMANATION OF EQUAL INITIAL STRENGTH

| Radium | Emanation | Radium | Emanation | Radium | Emanation | Radium | Emanation |
|---|---|---|---|---|---|---|---|
| 1 | 1.0 | 11 | 11.5 | 21 | 22.8 | 31 | 35.4 |
| 2 | 2.0 | 12 | 12.6 | 22 | 24.0 | 32 | 36.6 |
| 3 | 3.0 | 13 | 13.7 | 23 | 25.3 | 33 | 37.9 |
| 4 | 4.0 | 14 | 14.8 | 24 | 26.5 | 34 | 39.3 |
| 5 | 5.1 | 15 | 15.9 | 25 | 27.7 | 35 | 40.6 |
| 6 | 6.1 | 16 | 17.0 | 26 | 29.0 | 36 | 42.0 |
| 7 | 7.1 | 17 | 18.2 | 27 | 30.2 | 37 | 43.4 |
| 8 | 8.2 | 18 | 19.3 | 28 | 31.5 | 38 | 44.8 |
| 9 | 9.3 | 19 | 20.5 | 29 | 32.8 | 39 | 46.2 |
| 10 | 10.4 | 20 | 21.6 | 30 | 34.0 | 40 | 47.6 |

Definite measurements are available on the intensity of this secondary electron emission under various conditions. Eve[6] measured with an electroscope the intensity of the electron emission from sheets of different elements for γ-rays filtered through 2 cm. of lead, separating the emission from the two sides of the sheets. The ionization in his electroscope due to electrons coming out of the side of the sheet upon which the γ-rays were incident as plotted in Figure 10 as the "incidence" curve, while the curve marked "emergence" gives the ionization caused by emission from the side of emergence of the γ-rays.[7] The preponderance of emission in the emergence direction for light elements has its explanation in the quantum theories of radiation. As the atomic number of the screen is decreased, an increasing proportion of the secondary electrons is made up of electrons recoiling under the impact of the quanta of γ-rays, which they deflect, or "scatter." These recoiling electrons obey the laws of conservation of energy and momentum in the impact and thus always go in the forward direction, in fact, with γ-rays, nearly all proceed at an angle less than 45° from the direction of motion of the primary γ-ray. With the heavier elements, on the other hand, the recoil electrons become few in number compared with photo-electrons. Photo-electrons result when the γ-ray quanta are absorbed instead of deflected, and have a distribution in space quite different from that of the recoil electrons, so that the total emission from heavy elements is approximately the same from the incidence and emergence sides. The emergence ionization as a function of thickness of the sheet is plotted in Figure 11 for aluminum and lead from measurements by Bragg.[8] The ionization increases with thickness until the electrons starting at the incidence side of the sheet are unable to reach the emergence side; further increase in thickness simply reduces the intensity of the γ-rays without adding to the number of electrons emitted.

On the basis of Figures 10 and 11 then, the best foils to put in contact with double-emulsion films for γ-ray work would be lead for the side farther from the radium, and lead or aluminum on the near side; the lead foil should be from 0.2 to 0.4 mm. thick for maximum effect, and the aluminum 2 mm. or more. An actual test with X-rays through 4 inches of steel with 2 mm. aluminum, 0.15 mm. lead, and 0.3 mm. lead on the radium side of films proved that lead is preferable to aluminum both for speed and definition; 0.15 mm. of lead appeared slightly more effective than 0.3 millimeter.

Materials which fluoresce under the action of γ-rays can be made into effective intensifying screens as has been done for X-ray radiography. Calcium tungstate screens are satisfactory in the γ-ray region, although their effectiveness in shortening exposure times for γ-rays is not as great as for high voltage X-rays. When used with X-rays their intensifying action increases with the hardness of the rays; that this increase does not continue into the γ-ray region of wave lengths is seen from the measurements of Figure 12. Scattered γ-rays reaching the

[6] A. S. Eve: Philosophical Magazine of London, Edinburgh, and Dublin, 1909, XVIII, 275.

[7] No importance should be attached to the actual values of the ionization plotted here, for an unknown but constant amount must be subtracted from these values to correct for ionization from causes other than those here discussed.

[8] W. H. Bragg and J. P. V. Madsen: Philosophical Magazine of London, Edinburgh, and Dublin, 1908, XVI, 918.

film from the rear, in radiographic work, are considerably longer in wave length than the original γ-rays and might fall within the range of greatest intensifying action for calcium tungstate screens. If this were the case it would be doubly important to shield radiographic films from side and rear scattering when using such screens.

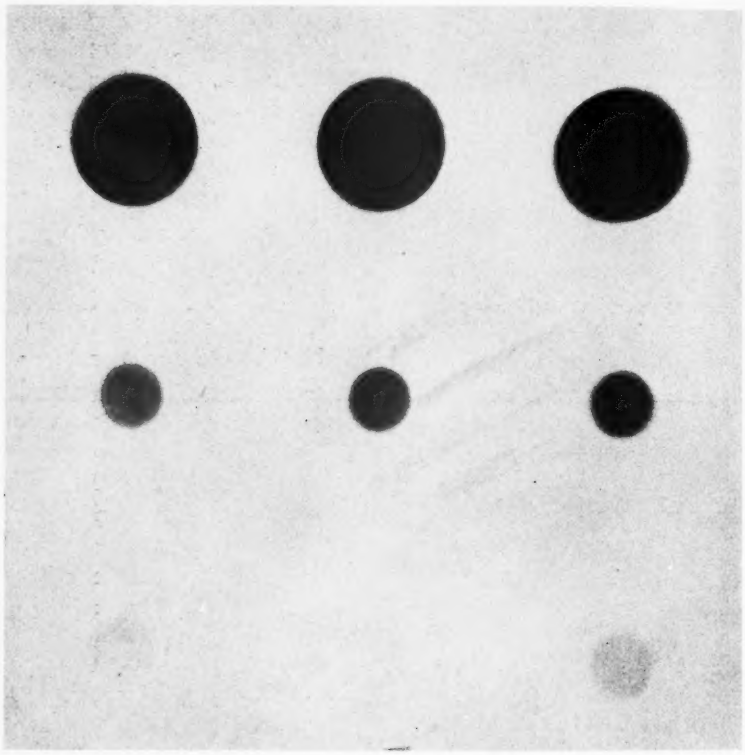


Fig. 5. Radiograph of drilled steel plate, shown in Figure 1, with total thickness of 1½ inches; distance, source to film, 18 inches; exposure, 175 milligram-hours, using three lead screens and two films. Dimensions of holes: (top row) 1 inch diameter; 1½ inches, 1 inch, and ¾-inch deep: (middle row) ½-inch diameter; 5/16-inch, ½-inch, and 3/8-inch deep: (bottom row) ½-inch diameter; 3/16-inch, 1/8-inch, and 1/16-inch deep.

The characteristics of Eastman Superspeed Dupli-tized X-ray films under various conditions are shown in Figure 13. The method of obtaining the data was as follows: A lead cylinder 8 inches in diameter with a hole 1 inch in diameter extending through it was used to collimate a beam of γ-rays from 250 millicuries of radium emanation placed at the bottom of the hole. The films under test were placed on the top of a block of iron 1 inch thick placed over the hole, and were 9 inches from the radium. Exposures of from 1 to 32 minutes were made and the films over-developed with the technic described above. Densities of the unexposed film and the exposed spots were calculated from measurements on a Kipp and Zonen microphotometer by taking

the logarithm to the base of the ratio of intensities of light passing through an undeveloped, fixed, washed, and dried film, to the intensity of the light passing through the film whose density was desired. That is, the density was taken as

$$\log_e \frac{\text{light incident on the emulsion}}{\text{light transmitted by the emulsion}}$$

The density due to the fog alone (amounting to about 1.15) was then subtracted from the densities of the exposed portions for each film and the difference plotted against the exposure time in Figure 13. The results show films surrounded by two Patterson screens to be the fastest of those tried, then, in order, one Patterson screen and one lead screen, two lead screens, and finally plain film without screens. Radiographic exposures made with two Patterson screens require about 0.6 the time required without screens, while with two lead screens this fraction is about three-quarters.

In all our radiographic tests we have used duplicate films. There is a considerable advantage in making a simultaneous exposure on two films; not only may the exposure be shortened, but, perhaps more important than that, the irregularities in the emulsions originating in manufacture and subsequent handling do not occur in the same spots on both films and are, therefore, averaged out. A great deal more confidence is felt in interpreting a faint marking as caused by a defect in a radiographed specimen if the same marking is seen on two films. The advisability of using more than two films appears questionable to the authors, however. The "confidence factor" does not increase appreciably, and the density due to the fog alone, with all the films combined, becomes too great—at least with the developing technic used in this work. Of course, the film costs also increase with the multiplicity of films used.

Two arrangements found convenient when using a pair of films are: lead—film—lead—film—lead, or when using fluorescent screens: screen—film—lead—film—screen. With these arrangements the films are separated only by the thickness of one lead sheet, and are contained in a single film holder, two conditions that are obviously desirable.

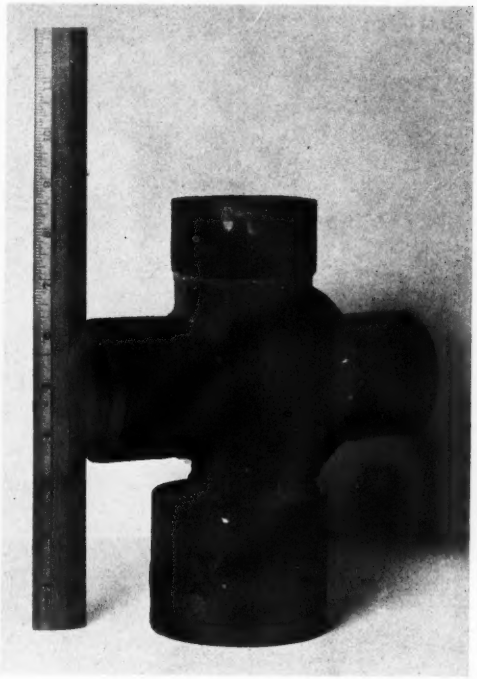


Fig. 6. Photograph of bronze valve casting of which radiograph is shown in Figure 7.

## EXPOSURES NECESSARY

Upon penetrating a substance $\gamma$-rays decrease in intensity by absorption and scattering. The rate of decrease appears different when measured with different arrangements of apparatus. This has been shown to be the effect of varying amounts of the scattered rays reaching the measuring instrument along with the primary rays.[9]

[9] For summaries of this work see Rutherford: "Radioactive Substances and Their Radiations," Cambridge, 1913, pages 258-263; Meyer and Schweidler, "Radioactivität," pages 149-156; Handbuch der Experimental Physik, XV, 70-74.

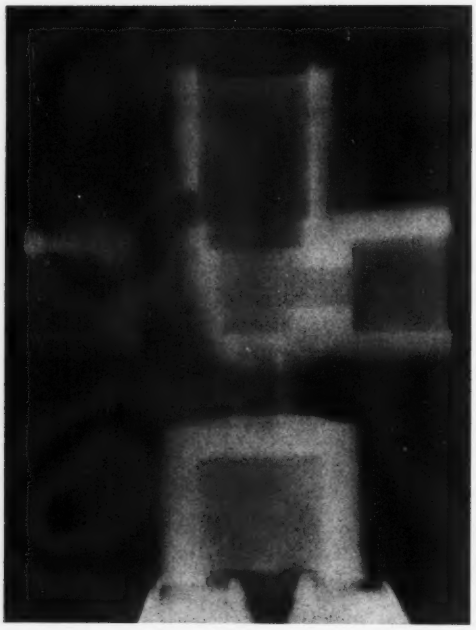


Fig. 7. Radiograph of bronze valve casting shown in Figure 6. Distance, source to film, 27½ inches; exposure, 1,600 milligram-hours; two lead screens; one film. Several flaws are visible in the original film.

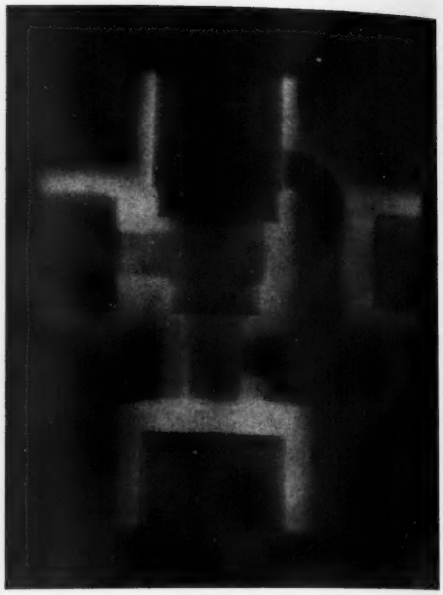


Fig. 8. Radiograph of a machined bronze valve casting. Distance, source to film, 27½ inches; exposure, 1,600 milligram-hours; two lead screens; one film.

The position of radium, specimen, and film in radiography is a particularly poor one for getting the true rate of decrease of the primary ray since the film receives a maximum amount of the scattered rays. Therefore, accurate measurements of true absorption, made with the absorbing screen near the radium and far from the measuring device to eliminate the effect of scattering, cannot properly be used to calculate the intensity striking the film in a radiographic exposure.

Absorption measurements under conditions approximating those of radiography were made by Soddy and Russell,[10] K. W. F. Kohbrausch[11] and others. It was found that the intensity of a ray of original intensity $I_o$ after passing through a thickness x of a metal of density $\rho$ was

$$I = I_o e^{-\mu x} = I_o e^{-\left(\frac{\mu}{\rho}\right)\rho x}$$

where $\mu$ is the linear absorption coefficient and $\left(\frac{\mu}{\rho}\right)$ the mass absorption coefficient. Some values found for these coefficients are given in Table III. Soddy and Russell found a constant value of $\mu$ in lead from 2 to 22 cm. thick, and similarly found constant values over large ranges of thickness in other materials. Later observers were

TABLE III.—ABSORPTION COEFFICIENTS FOR γ-RAYS FROM RADIUM ACCORDING TO SODDY AND RUSSELL

| Metal | $\mu$ (cm.$^{-1}$) | $\mu/\rho$ |
|---|---|---|
| Fe | 0.304 | 0.0399 |
| Cu | 0.351 | 0.0398 |
| Brass | 0.325 | 0.0389 |
| Al | 0.111 | 0.0401 |
| Pb | 0.495 | 0.0434 |

[10] F. Soddy and A. S. Russell: Philosophical Magazine of London, Edinburgh, and Dublin, 1909, XVIII, 620. Mr. and Mrs. Soddy, and A. S. Russell: Philosophical Magazine of London, Edinburgh, and Dublin, 1910, XIX, 725.

[11] Summarized: Handbuch der Experimental Physik, XV, 71.

able to detect a hardening of the rays as they penetrated greater thicknesses, caused by the more rapid absorption of the softer components, and resulting in a progressive decrease in $\mu$ with increasing thickness, an effect doubtless hidden from the earlier investigators by the presence of considerable scattering in their work. Taking the simple exponential equation above as representing absorption in radiography, the exposure time required to give a certain density on a photographic film behind x cm. of metal varies with the thickness according to the relation

$$t = t_0 e^{\mu x} = t_0 e^{\left(\frac{\mu}{\rho}\right)\rho x}$$

where $t_0$ is the time required with $x = 0$. The derivation of this equation assumes (1) that a constant source of intensity is used, (2) that the effect on a film is the product of intensity times time, a valid assumption, and (3) that the film is completely protected by lead shields from scattered rays reaching

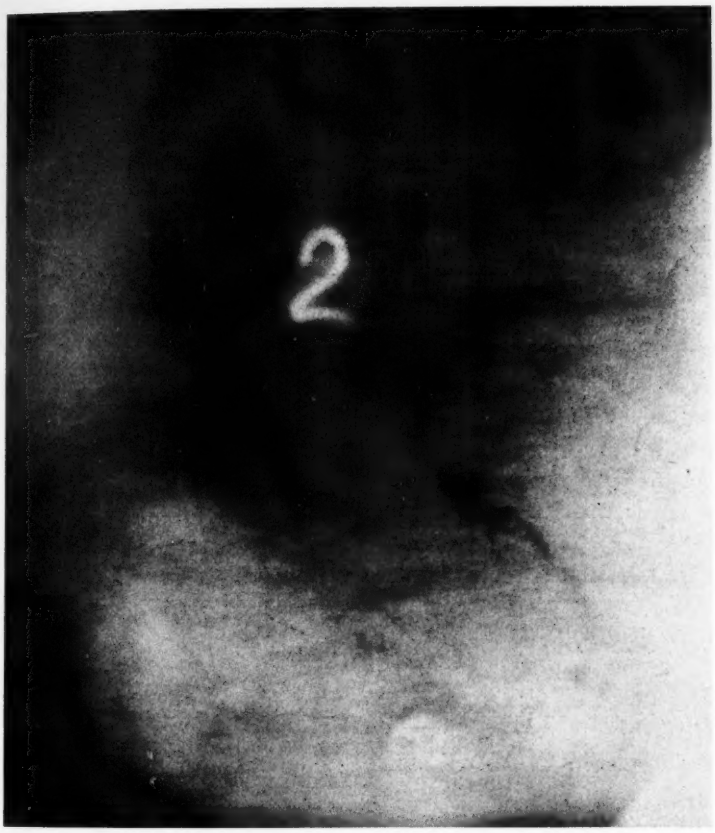



Fig. 9. One of the radiographs of the large casting shown in Figure 3. A long crack, slightly obscured by streaks due to irregularities in the surface of the casting, is seen below and to the right of the lead identification figure "2." Exposure, 5,100 milligram-hours, with three lead screens, two films; distance, source to film, 31 inches.

it from the rear (excited by primary rays striking the walls, floor, etc.).

As there was some doubt as to just how well the above formula and values of Table III would serve to establish radiographic exposure times, it was decided to determine exposure times under actual conditions.

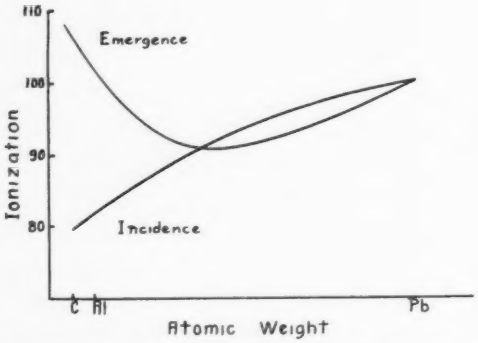



Fig. 10. Ionization produced by secondary electrons from screens of various atomic weights when radiated by gamma rays from radium (A. S. Eve).

Steel plates 12 inches square and steel disks 16 inches in diameter were arranged about a holder of radium emanation as shown in Figure 1. Films were shielded from $\gamma$-rays scattered from walls and floor by lead sheet $\frac{1}{8}$ inch thick shown tied to the back of the piles of plates. Various slots and holes were cut in the plates next to the emanation to test the thickness of defect that could be detected. A distance of 18 inches from source to film was used throughout the test. With a given thickness of plates and type of intensifying screen two exposures were made and the density measured at points on the films corresponding to the full thickness of metal. The exposure times actually used were transformed to the times that would be required for corresponding exposures with 100 milligrams of radium. Plotted on semi-logarithmic paper these times and densities, for a given thickness, gave two points on a curve of the type shown in Figure 13. These points located the time-density curve with sufficient accuracy since only the position of the curve along the time axis, not its shape, is affected by the thickness of the absorbing plates. The time required to give any desired degree of blackening could then be read from the curve. Such exposures were used that the desired point lay either between the two used, or very close to one.

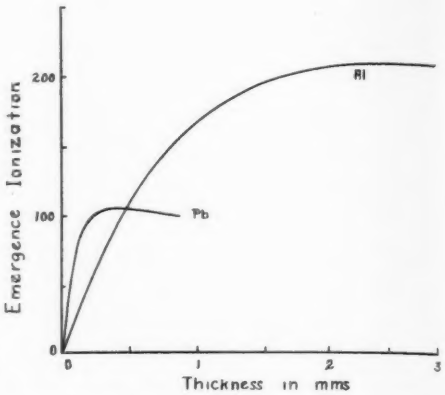



Fig. 11. Ionization on the emergent side of screens of various thicknesses, when radiated by gamma rays of radium (Bragg and Madsen).

The proper amount of blackening for radiographs has been studied in detail by Neeff[12] but it is difficult to believe that the optimum density for viewing small changes in density of a film is independent of the intensity of the viewing light, as he appears to assume. For viewing two superimposed films, each of which shows rather more fog than usual because of the method of overdevelopment used, the optimum density recommended by Neeff can hardly be given much weight. We have chosen a density, including fog, of 2.20 (in natural logarithms); with this blackening flaws 2 to 3 per cent of the specimen's thickness are seen with specimens from 2 to 6 inches thick.[13]

[12]Th. Neeff: Ztschr. f. tech. Physik, 1925, VI, 208-216; reviewed by Glocker: "Materialprüfing mit Röntgenstrahlen," Springer, Berlin, 1927, pages 65-69.

[13]In the absence of scattering, the ability to detect a hole is independent of the thickness of the specimen, since it leads to an increase in the intensity reaching the film by a factor of $e^{\mu d}$ where d is the depth of the hole and $\mu$ the absorption coefficient of the metal. In practice, this relation does not hold, for scattering is present and is a function of the thickness.

This density is suitable for viewing two superimposed films simultaneously and is also satisfactory for viewing a single film in close contact with white paper by reflected light.

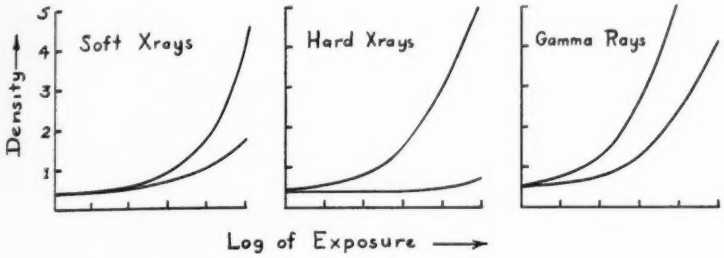



Fig. 12. Effect of Patterson screens on film density with radiation of different wave lengths. Upper curves, density with screen; lower curves, density without. Soft X-rays from molybdenum tube at 30,000 volts, A.C.; hard X-rays from tungsten tube at 140,000 volts, D.C., filtered through 4.5 mm. copper; gamma rays from radium emanation filtered through 1 inch of iron.

The results of the test are given in Figure 14. For thicknesses above two inches the slope of the curves has been made to correspond to a linear absorption coefficient of $\mu = 0.304$, in agreement with Soddy and Russell's value (Table III). Curves are given for two arrangements of screens and one density; data for other screens or other densities can be obtained from these by multiplying the exposure times by suitable factors (equivalent to a displacement of these curves along the axis of abscissas).

It will be seen from Table III that the mass absorption coefficient, $\left(\frac{\mu}{\rho}\right)$, has nearly a constant value for different elements. From the exposure time equation above it is seen that the following convenient approximate rule can be formulated: the exposure necessary for x inches thickness of a metal of density $\rho$ is the same as that necessary for $\rho x/7.8$ inches of steel, where 7.8 is the density of steel. This was tested with aluminum ($\rho = 2.7$) by giving a 5-inch thickness the exposure necessary for $2.7 \times 5/7.8 = 1.73$ inches of iron; the resulting blackening was that expected within the limit of accuracy of the experiment. This rule is convenient when making up a plaster to coat the surface of an irregular casting for the purpose of eliminating shadows of surface defects from the radiograph. Any plaster will do that has the same density as the casting.

The exposure necessary for a radium-to-film distance of d inches can be obtained from the exposure at 18 inches by multiplying the latter by $(d/18)^2$. The distance used in practice will depend upon the number and size of objects that are to be radiographed at one time and upon the definition—the sharpness of the image—that is desired. The smaller the source and the greater its distance from the defect, the greater the sharpness of the defect's shadow. Another important advantage obtained with a greater distance is a more uniform intensity over the area of the film. For the most economical use of radium, the objects to be tested should be placed about the radium to cover the greatest possible fraction of the total solid angle about it; they may be placed at such distances that the various thicknesses reach their completed exposures in the same number of hours. When the whole of the spherically radiated energy from the radium

is used in this way the cost per specimen is independent of the dimensions of the arrangement. It has been found that in many cases overnight exposures are most convenient. Table IV gives necessary radium and radium emanation strength for overnight exposures for various thicknesses and distances calculated from the data given above.

Due to the lower absorption coefficient of $\gamma$-rays it is easier to obtain suitable radiographs of specimens of irregular thickness

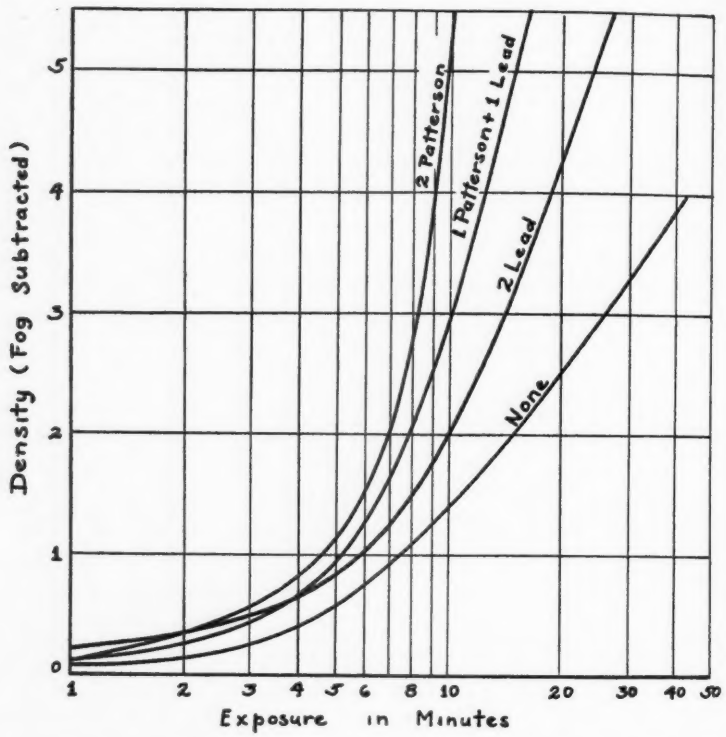



Fig. 13. Characteristics of films with different intensifying screens for gamma rays from radium emanation filtered through 1 inch of iron.

TABLE IV.—STRENGTH OF RADIUM IN MILLIGRAMS AND INITIAL STRENGTH OF EMANATION IN MILLICURIES REQUIRED FOR AN OVERNIGHT EXPOSURE (15 HOURS) AT THE DISTANCES AND THROUGH THE THICKNESS INDICATED, W TH TWO LEAD SCREENS, DUPLI-TIZED SUPER-SPEED X-RAY FILMS, OVER-DEVELOPMENT, AND FILM DENSITY OF 2.20

| Thickness of iron in inches | Source to film, distance in inches | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 12 | | 18 | | 24 | | 30 | |
| | Ra | Em | Ra | Em | Ra | Em | Ra | Em |
| 1 | 5.3 | 5.6 | 12.0 | 12.7 | 21.3 | 22.5 | 33.3 | 35.2 |
| 2 | 12.6 | 13.3 | 28.3 | 29.9 | 50.3 | 53.1 | 78.6 | 83.0 |
| 3 | 29.3 | 31.0 | 66.0 | 69.7 | 117.3 | 123.8 | 183.3 | 193.6 |
| 4 | 63.0 | 66.6 | 141.6 | 149 6 | 251.6 | 265.8 | 393.1 | 415.3 |
| 5 | 132.5 | 140.0 | 298.2 | 315.0 | 530.0 | 560.0 | 828.1 | 875.0 |
| 6 | 296.5 | 313 | 666 6 | 704 | 1185 | 1252 | 1852 | 1956 |

with them than with X-rays. Exposures for irregular pieces should be figured on the basis of the thick sections rather than the edges of the casting's shadow. A radiograph with X-rays under the same conditions would have shown a great deal of halation.

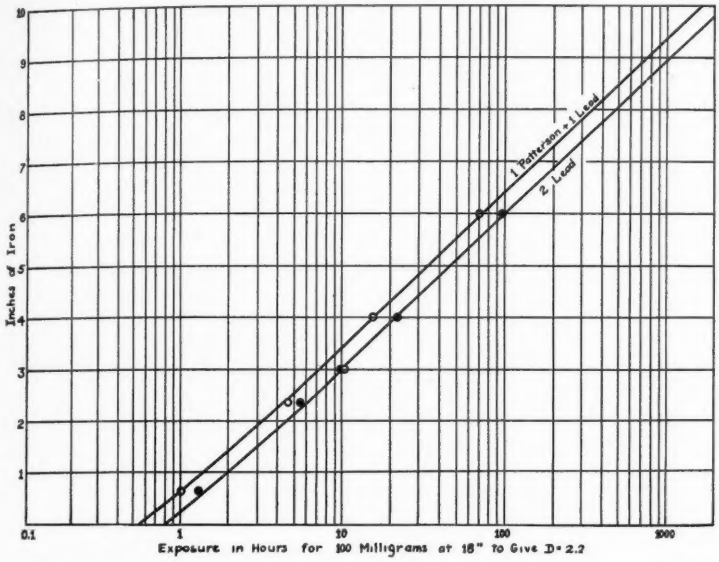



Fig. 14. Exposure times for radiography with gamma rays from radium. Conditions assumed: constant source of 100 milligrams at 18 inches from film, using intensifying screens indicated. Resultant density (with over-development) suitable for simultaneous viewing of two films.

thin ones, for densities considerably greater than the one recommended above are not detrimental (except in possibly preventing simultaneous viewing of films). Under-exposures, on the other hand, are unsatisfactory. Gamma-ray films are less contrasty than X-ray films because of the lower absorption coefficient of $\gamma$-rays. While this limits the usefulness of $\gamma$-rays for very thin specimens, it is not serious for most work.

## SCATTERING OF GAMMA RAYS

The radiographs reproduced in Figures 7 and 8 were taken without precautions against the direct rays striking the film at the edges of the casting, and without shielding from scattering from the other castings arranged about the radium simultaneously, yet there is an almost complete lack of halation at the edges. There are two reasons for the difference. In the first place, ratio of the intensity of the unabsorbed rays to that of the rays that have passed through the casting is much greater for X-rays than for $\gamma$-rays. Since the amount of scattering from adjacent objects and from the part of the film itself exposed to the direct rays is proportional to this ratio, it is greater in the X-ray case. In the second place, the angular distribution of the intensity of the scattered rays is a cause of less halation with $\gamma$-rays. The intensity of scattering as a function of angle is plotted radially in Figure 15 for $\gamma$-rays filtered through 1 cm. of lead.[14]

[14] A. H. Compton: Philosophical Magazine of London, Edinburgh, and Dublin, 1921, XLI, 749-769. This distribution has a satisfactory explanation in the quantum theory of the Compton effect, the most recent form of the theory being that of Klein and Nishina (O. Klein and Nishina: Ztschr. f. Physik, 1929, LII, 853, and Nature, 1928, CXXII, 398), which predicts the observed intensities accurately when a wave length of 0.01 A.u. is assumed for the $\gamma$-rays. For earlier theories see A. H. Compton: "X-Rays and Electrons," Van Nostrand Co., 1926, pages 296-305.

The proportion of scattering at large angles increases with increasing wave length and is one of the causes for the need of careful shielding of the film when using X-rays. The Bucky diaphragm, a device of multiple slits placed between the specimen and the film and very useful in radiography of the human body with the long wave lengths necessary for that purpose, could not be expected to add much to the quality of γ-ray radiographs. Its purpose is to prevent radiation scattered at an angle greater than a certain given angle from reaching the film. It is, therefore, an artificial method of producing a distribution of scattered rays of the favorable type shown in Figure 15 and would naturally be most effective when the original distribution differed most from this, *i.e.*, with soft X-rays.

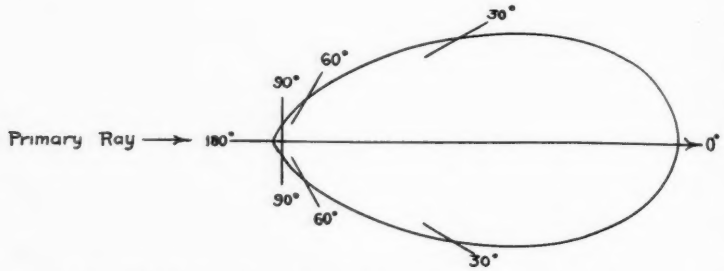



Fig. 15. Distribution in angle of intensity of gamma rays from radium scattered by iron (A. H. Compton).

The wave length of the scattered rays is another factor to be considered, for it is much greater than that of the primary rays. If the primary wave length be taken as 0.010 Å.u., then a ray scattered at 90° has a wave length of 0.034 Å.u. and at 180°, 0.058 Ångström unit. With this increase in wave length goes a decrease in the hardness of the ray. This is so pronounced that at large angles of scattering the rays are no harder than high voltage X-rays.

Knowledge of these factors enables a calculation to be made of the area of film which will be fogged by the scattering from a given point in a specimen being radiographed. Taking measurements of Compton's[15] we have estimated the relative intensity of scattered γ-rays reaching different points at the rear of a lead sheet 1 inch thick, assuming a small element of volume on the radium side of the sheet as the only source of scattering. Because of the distribution-in-angle of intensities, the softening upon scattering, the different thicknesses traversed by the scattered rays, and the weakening according to the square of the distance from the source of scattering, this element of volume can cause fogging over a circle only an inch or so in diameter, as shown in Figure 16. (The intensity of the primary ray is not indicated in the figure.) While this example represents a simplified case not found in practice, it is sufficient to show an important point, namely, that a specimen of great length and breadth can be radiographed with practically no more fogging from scattering arising in the specimen than one would experience with a small specimen of the same thickness.

For best results films should be shielded from scattered rays reaching them from the rear (originating in the walls and floor of the room), although the amount of this is not excessive. Figure 4 taken through 4 inches of steel had part of the film pro-

[15] A. H. Compton: Philosophical Magazine of London, Edinburgh, and Dublin, 1921, XLI, 749.

tected from this rear scattering by an ⅛-inch thickness of lead; another part was protected by a ¼-inch thickness. As is seen, the fog was reduced by the ⅛-inch sheet, but no further reduction was effected by the additional ⅛-inch.

### OPERATIONS IN PRACTICE

An imaginary case will serve to illustrate the process of taking γ-ray radiographs with the technic recommended above and will indicate the simplicity of the method. Let us assume that radiographs are to be taken of two castings, one of steel of maximum thickness (in the direction it is desired to send the rays) of 4 inches, the other of bronze of maximum thickness 3 inches, and suppose that the source available for the work is radium emanation of strength 350 millicuries at the time the exposure is to start, enclosed, say, in a small needle-shaped container.

The initial cost of lead foil for intensifying screens is much less than that of calcium tungstate screens. The choice between these two types will depend on whether the saving in radium costs through the use of the more efficient calcium tungstate screens will pay for their greater initial cost. In this example we will assume lead foil is used, and that properly designed film holders are on hand. A desirable arrangement in each film holder is to alternate two films and three lead screens.

The source assumed, being needle-shaped, amounts to nearly a point source if viewed from the ends, so the most advantageous position for the two castings is in line with the axis of the needle. Their distance from the needle will now be considered. The greater the sharpness desired in the radiographs, the greater must be the distance from source to film and the smaller must be the dimensions of the source. Larger films require greater distances than small films, in order to have uniform blackening over the surface of the film. Suppose comparison with previous results indicates the source-to-film distance should be at least 18 inches (a distance found satisfactory in the work in this Laboratory). The exposure may then be calculated for the larger casting using this distance.

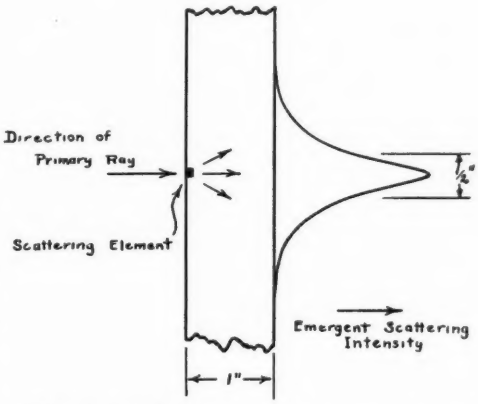



Fig. 16. Distribution of intensity over the back of a lead block, of gamma rays scattered by an element of volume in the front surface of the block.

From the chart of Figure 14 the exposure for 4 inches of steel at 18 inches with lead screens and Eastman Dupli-tized X-ray film is seen to be 21 hours for 100 milligrams of radium, or $21 \times \frac{100}{350} = 6.0$ hours for 350 milligrams. The equivalent exposure using radium emanation of 350 millicuries strength at the beginning of the exposure is obtained from Table II and is 6.1 hours.

The bronze casting may be placed at 18 inches and its exposure time calculated, or it may be placed at such a distance that it will require the same length of time as the steel casting. The latter scheme is often more convenient and will be assumed in this illustration. The thickness of 3 inches assumed for bronze is first to be reduced to its equivalent thickness of steel by multiplying by the density of the alloy and dividing by

the density of steel. An alloy of Cu 90 per cent, Sn 10 per cent, weighs 548 lbs./cu. ft.[16] and cast steel weighs 490 lbs./cu. ft.,[16] so the equivalent thickness of steel is $3 \times \frac{548}{490} = 3.35$ inches. Again referring to Figure 14, an exposure of 12.8 hours is required with 100 milligrams radium at 18 inches, therefore, $12.8 \times \frac{100}{350} = 3.66$ hours with 350 milligrams at 18 inches. The time of exposure varies as the square of the distance from the source, so to make the exposure in 6 hours with radium (6.1 hours with emanation) requires a distance d given by

$$\left(\frac{d}{18}\right)^2 = \frac{6}{3.66} \text{ or } d = 23 \text{ inches.}$$

A simple, rigid support of glass, wood or other light material is arranged for the source at a convenient place, preferably at a distance from large masses of matter in order to reduce scattering, and the castings placed at their proper distances from the source. Films in their holders are fastened so as to receive the shadows of the castings, and sheet lead is placed at the sides and rear of the films as a protection against scattered rays. The radium emanation is placed in its holder with tongs as quickly as possible after it arrives. The operator may then leave, returning at the conclusion of the exposure to remove the emanation. Obviously the source of $\gamma$-rays should not be left in the vicinity of the films before or after exposure. Development of the films in the dark room is a simple operation if proper film hangers and developing tanks are used. Development by time and temperature is always best.[17] The exposure times given are minimum values for the following conditions of development: the standard X-ray developer contains 20 milligrams of potassium iodid; and the time during which the film is left in this developer is twice that usually employed. If ordinary development is used or if greater density of films is desired, longer exposures than those given above will be needed.

Duplicate radiographs may be fastened together with paper clips and viewed simultaneously, to increase the visibility of defects and to eliminate irregularities in the films.

[16] National Metals Handbook of the A.S.S.T., 1930, page 17.

[17] For dark room technic see "X-rays in Industry," Eastman Kodak Co., 1929.

## SUMMARY

A technic for taking radiographs by means of $\gamma$-rays is given, with charts and tables of exposure times for radium and for radium emanation.

Factors influencing the quality of radiographs and the rapidity of photographic action with $\gamma$-rays are discussed.

# GASTROJEJUNOCOLIC FISTULÆ[1]

By H. W. WIESE, B.S., M.D., St. Louis, Missouri

OUR attention has recently been called to the condition of gastrojejunocolic fistula by the appearance of a case on the medical service of Barnes Hospital. This patient presented characteristic symptoms and X-ray findings, and was subjected to successful surgical treatment. Upon review of our hospital records another case was found which had been admitted with a clinical diagnosis of purpura. In the latter instance the patient died within twelve hours of admission to the hospital and the fistula was not suspected until the autopsy.

## SUMMARY OF CASES

Case 1. A. C., aged 31, a white male, married, was admitted to Barnes Hospital from the Outpatient Department in October, 1929. He complained of diarrhea, of pain in the abdomen, and also of pain in the muscles.

*Past history:* The patient had had frequent attacks of tonsillitis, and a peritonsillar abscess three years before admission. Fifteen years previous to the present examination he began having a burning pain in the epigastrium two hours after meals. This was relieved by food and soda. He was treated medically for several years, without relief. In 1923 he had a gastroenterostomy, after which his symptoms improved but he was not entirely free of discomfort. In 1925, the pain again becoming quite severe, the man received hospital treatment for thirty-four days on a rigid ulcer régime. He then followed a similar but ambulatory régime for two years, with considerable benefit, but upon resuming a normal diet, the severe symptoms returned. He then resorted to a diet of his own choosing and was quite comfortable until the onset of the condition from which he now sought relief.

Fig. 1. Case 1. The opaque meal showing the filling of the distal transverse colon *via* the gastrocolic fistula.

The present illness began six months previous to admission, with a diarrhea which resulted in five or six stools each night, and two or three stools each day. The fecal matter was watery and contained some mucus. There was cramping in the lower abdomen below the site of his original ulcer pain. He consulted a physician and underwent a gastro-intestinal X-ray examination, but no abnormality was found. He was given a diet and an antacid. The diarrhea increased, with three or four stools at night and ten to twelve during the day. Fourteen weeks before admission he became too weak to work and was confined to bed. Two weeks later, he began to have a dull aching pain

[1]From the Department of Medicine, Washington University, and Barnes Hospital, St. Louis, Mo.

Fig. 2. Case 1. The opaque enema showing the canalization of the gastrocolic fistula, and the filling of the stomach from the colon.

in the arms and legs, not localized to the joints. Two weeks after that, edema of the ankles and puffiness of the face appeared. Hemorrhoids developed. Seldom was there fever. He had lost twenty pounds in weight during the past six months. The appetite remained good throughout.

The physical examination revealed a pale, poorly nourished man, without fever. Eyes, ears, nose, throat, lungs, and heart were not notably other than normal. The blood pressure was 132 mm. systolic and 88 mm. diastolic. The abdomen showed an upper right paramedian scar of an operation for gastro-enterostomy, and a scar of an appendectomy at the McBurney site. There was a slight diffuse tenderness in the right upper quadrant.

The red cells were 3,370,000; the white cells 9,100, and the hemoglobin 70 per cent. The blood Wassermann and Kahn serum reactions were negative. The non-protein blood nitrogen was 26 mgm. per 100 cubic centimeters. A gastric analysis revealed much mucus and débris in the contents of the fasting stomach, without free hydrochloric acid, and a combined acidity of 1 degree. A guaiac test for occult blood was faintly positive. At 20 minutes after the test meal the free acid was 10° and the combined acid 1°; at 40 minutes, free acid and the combined acid were 2° and 1°, respectively, and at 60 minutes 5° and 2°, respectively. The stool gave a moderately positive guaiac reaction for occult blood. The urine was negative. The roentgenologic examination showed the gastric clearance to be occurring *via* three openings: the pylorus seemed to have ready clearance; the gastro-enterostomy was functioning, and a gastrocolic stoma canalized readily. The duodenal cap was atypical in shape but without any irritability suggestive of an active ulceration. The second duodenum was markedly hypotonic. A barium enema readily canalized the gastrocolic fistula and the stomach filled promptly by this means.

At an operation Oct. 17, 1929, by Dr. Glover H. Copher, the scar of the original ulcer was found in the first portion of the duodenum. The loop of the jejunum distal to the gastro-enterostomy was inflamed and adherent to the colon. A gastrojejunocolic fistula was made out. The jejunum was separated from the colon, and the opening in the colon was sutured. The gastro-enterostomy was separated, the stomach closed, and a portion of the jejunum was excised and continuity restored. The post-operative course was uneventful and the patient was discharged from the hospital Nov. 15, 1929, and has since been observed in the Outpatient Department. During the first three months post-operative he gained thirty pounds in weight, and he has been entirely free of all symptoms.

Case 2. W. A. R., aged 61, a white male, single, was brought into Barnes Hospital Nov. 25, 1928, in a comatose condition. Because of this, it was impossible to secure a

detailed history. It was determined that he had had typhoid at the age of 20, pneumonia at 21, and that ten years previously he had been operated upon in New York City for a duodenal ulcer. During the past five years, he had had five or six bowel movements a day. The stools did not contain blood or mucus. During the five weeks prior to admission to the hospital he had received "serum treatment" in a clinic not affiliated with this institution.

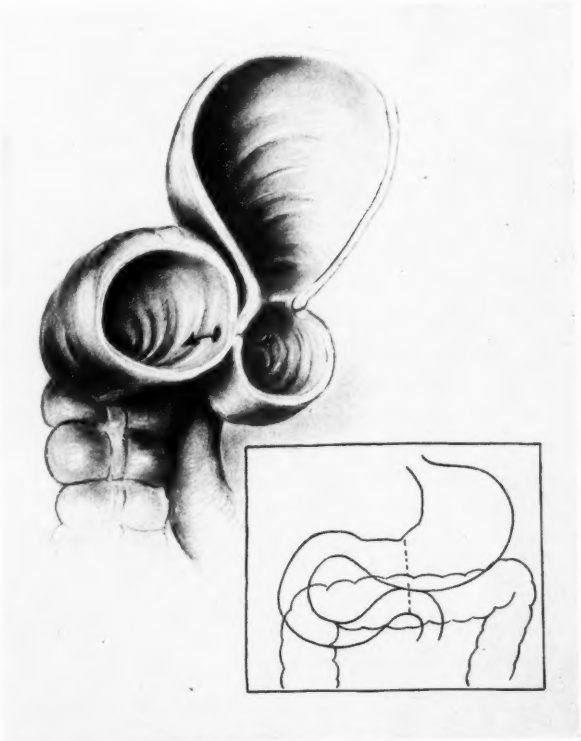


Fig. 3. Case 1. Sketch showing the fistula and the relations of the segments as found at operation.

A physical examination showed a stuporous patient having a temperature of 36° C. and a pulse of 140, which was weak and irregular. The pupils were small, and the right was, besides, slightly irregular and gave no reaction to light. There were petechiæ on the under-surface of the nose. The gums, and the hard and soft palates showed many purpuric spots. There was a definite purpura over the entire trunk. A few moist râles were found in the base of both lungs. The blood pressure was 60 mm. systolic and 40 mm. diastolic. The abdomen showed a long upper right paramedian scar, but otherwise was not notable. Rectal examination revealed a slightly enlarged prostate. There was a distinct swelling in the midline of the perineum, with some tenderness and no redness.

The red blood count was 3,550,000, the white cells were 18,400, and the hemoglobin 60 per cent. The blood Wassermann and Kahn reactions were negative. The non-

protein blood nitrogen was 125 mgm. per 100 cubic centimeters. A blood smear showed only slight irregularity of the red cells. A fair number of platelets were visible. With catheterization, much blood drained out, reducing the mass in the perineum, and the catheter had evidently entered a blind cavity.

The patient's condition became rapidly worse and he died the morning after admission.

At autopsy the only findings referable to the subject of this paper was an anastomosis of the posterior wall of the stomach to the first part of the jejunum. The distal stomach had been partially resected. The proximal duodenum was buried in the pancreas. The transverse colon was firmly adherent to the gastro-enterostomy. After the stomach was opened a finger could be passed readily into the colon as well as into the small intestine.

Prior to 1903, 70 cases of gastrocolic fistulæ were reported, which had developed secondary to carcinoma of the stomach or of the colon. Haller (1) reported the first case in 1755 and Murchison (2) reported the first group, numbering 33, in 1857. In 1897 Bec (3) increased the group to 63, and in 1903 it was further increased to 70 by von Koch (4). The first case of gastrojejunocolic fistula was reported by Czerny (5) in 1903. This fistula followed the operation of gastro-enterostomy for gastric ulcer. The report appeared four years after Braun (6) had first described a case of gastrojejunal ulcer, in 1899. In 1921 Loewy (7) compiled from the literature a group of 76 cases of gastrojejunocolic fistula. By that time 185 instances of gastrocolic fistula of various types had been reported. In 1925 Verbrugge (8) compiled from the previous literature 202 cases of gastrocolic and gastrojejunocolic fistulæ. Seven among these had been reported from the Mayo Clinic. To these he added 14 cases from that Clinic. Of this total of 216, 95 had followed upon a gastrojejunal ulcer, which had developed at a posterior gastro-enterostomy. The other 121 cases occurred in the course of primary abdominal disease. Since 1925, there have appeared in the literature 30 more cases, of which 22 occurred after gastro-enterostomy done for peptic ulcer and 7 from carcinoma of the colon or of the stomach. One was said to have been due to a "misadventure." Of the fistulæ following upon gastro-enterostomy, six were reported by Macdonald (9), three by Brock (10), and one each by Dejardin (11), Bradbury (12), Shangle and Beisler (13), Cabot (14), Kauftheil (15), Küttner (16), Wittkowsky (17), Robertson (18), Shore (19), Monroe and Emery (20), Pratt (21), and Lahey and Jordan (22). Of the fistulæ resulting from cancer, Brock (10), Hill (23), and Lambret and Razemon (24) each reported one, and Dickson (25) reported four, together with a case caused from a jejunal ulcer and another due to "misadventure," as mentioned above. The two cases of gastrojejunocolic fistula reported above occurred after gastro-enterostomy for duodenal ulcer and bring the number in that category up to 119, and the total of all types to 248.

Gastrocolic and gastrojejunocolic fistulæ, resulting from malignancy either of the stomach or of the colon, are becoming less frequent because of the earlier diagnosis of cancer. On the other hand, fistulæ following gastro-enterostomy have become more frequent. The chief factor in the etiology of the latter type of fistula is the occurrence of a perforation of a gastrojejunal ulcer, and the incidence is considerably less than that of these ulcers, which is given in the American literature (excluding the figures of Lewisohn) as from 2 to 5 per cent of all gastro-enterostomies, and in the German literature as from 5 to 10 per cent. They occur eleven times more often in men than in women, and Verbrugge found that of the

patients seen at the Mayo Clinic who had a gastrojejunal ulcer, 11.36 per cent developed a gastrojejunocolic fistula. Bolton and Trotter (26) found 10 per cent in a similar analysis and Lion and Moreau (27) 12 per cent.

The symptoms are fairly well represented in Case 1. Quite often, in addition to the diarrhea, cramping, and loss of weight, there is feculent eructation or vomiting. These symptoms vary in degree according to the size and directness of the fistula. The diarrhea may be of sudden onset in the course of a syndrome characteristic of marginal ulcer. The stools are liquid, contain undigested food, little mucus, and no pus or blood. They do not resemble those of colitis. However, one of the cases reported above was treated elsewhere upon that diagnosis. The absence of diarrhea does not contradict the diagnosis. Monroe and Emery (20) have reported two cases which were unusual in that neither had this symptom. The eructation or vomiting of fecal material varies with the directness of the opening, but is usually present in some degree. Pain is rare. The pain of the marginal ulcer is generally relieved after the fistula occurs, and may be replaced by a different, usually cramping, discomfort, lower in the abdomen than was the ulcer pain. The loss of weight varies and may be considerable in case the condition fails of early diagnosis and resultant starvation and dehydration continue.

The diagnosis may be made from these symptoms, together with the history of an antecedent gastro-enterostomy, with or without the symptoms of gastrojejunocolic ulcer, or with the history of malignancy of the stomach or of the colon. The diagnosis is confirmed—and when the symptoms are of minor degree it is made—by the roentgen demonstration of the opening between the segments. This may be difficult and inconclusive in case the tract is small and indirect, and it may be necessary to use a dye, which, after ingestion with food, may appear promptly in the stool, or may be recovered by tube from the stomach when administered with an enema.

The treatment of the condition is surgical, the extent and nature of the procedure depending upon whether the segments are to be merely separated and closed, or the gastro-enterostomy, when present, be left, restored, or disconnected.

It appears evident that the factors which allow the development of a gastrojejunocolic fistula are those of the origin of the marginal ulcer. These may be enumerated as (1) carelessness in post-operative management; (2) causes similar to those of the original peptic ulcer; (3) the use of unabsorbable sutures; (4) trauma of the mucosa at operation, and (5) an inadequate position and patency of the stoma. Undesirable circumstances in the manner of treatment of the transverse mesocolon in performing a posterior gastro-enterostomy should be considered among the factors both of the marginal ulcer and of these fistulæ. The fistulous opening into the colon is a fortuitous occurrence in the penetration and perforation of the marginal or jejunal ulcer, and is classified according as the stomach and jejunum are separately or jointly involved in the opening. The communication may be so direct that there is scarcely any appreciable fistulous tract. This was the condition in the first case reported. On the other hand, the communication may be small and intermittently patent or have a valve action. This situation lessens the characteristic symptoms and makes the diagnosis of the condition more difficult.

## SUMMARY

1. Two cases of gastrojejunocolic fistula following gastro-enterostomy for duodenal ulcer are reported.

2. The literature has been reviewed and 30 cases of gastrocolic fistula collected, of

which 22 were gastrojejunocolic in type, following upon a gastro-enterostomy for peptic ulcer.

3. The condition may remain unrecognized, as in the second case, and may be susceptible to most successful treatment, as in the first.

## BIBLIOGRAPHY


(1) HALLER, Quoted by VOORHOEVE, N.: Deutsch. Arch. f. klin. Med., May, 1912, CVI, 294.

(2) MURCHISON, Quoted by VOORHOEVE, N.: Deutsch. Arch. f. klin. Med., May, 1912, CVI, 294.

(3) BEC, FRANCOIS: Thèse de Lyon, 1897.

(4) VON KOCH, PH.: Arch. f. Verdauungskr., 1903, IX, 1.

(5) CZERNY, VINCENZ: Beitr. z. klin. Chir., 1903, XXXVII, 765.

(6) BRAUN, H.: Verhandl. d. Deutsch. Gesellsch. f. Chir., April, 1899, XXVIII, 94.

(7) LOEWY, GEORGES: Les Fistules jèjunocoliques par ulcère perforant après gastro-entèrostomie. Paris, 1921.

(8) VERBRUGGE, JEAN: Arch. Surg., November, 1925, XI, 790.

(9) MACDONALD, IAN: Lancet, Oct. 15, 1927, II, 804.

(10) BROCK, R. C.: Guy's Hosp. Report, April, 1928, LXXVIII, 178.

(11) DEJARDIN: Jour. de Chir. et Ann. Soc. Belge de Chir., Nov. 24, 1928, XXVII, 272.

(12) BRADBURY, L. A.: United States Vet. Med. Bull., November, 1927, III, 1120.

(13) SHANGLE, MILTON A., and BEISLER, L. G.: Surg. Clin. North Am., December, 1926, VI, 1647.

(14) CABOT, RICHARD C.: Boston Med. and Surg. Jour., Oct. 27, 1927, CXCVII, 742.

(15) KAUFTHEIL, LEO: Wien. med. Wchnschr., Feb. 12, 1927, LXXVII, 225.

(16) KÜTTNER: Deutsche med. Wchnschr., May 28, 1926, LII, 922.

(17) WITTKOWSKY, CURT: Archiv. f. Verdauungskr., February, 1927, XXXVII, 386.

(18) ROBERTSON, WILLIAM E.: Proc. Sec. on Gastro-enterology and Proct., Am. Med. Assn., 1928, 103.

(19) SHORE, B. R.: Ann. Surg., April, 1928, LXXXVII, 578.

(20) MONROE, R. T., and EMERY, E. S., JR.: New England Jour. Med., May 3, 1928, CXCVIII, 550.

(21) PRATT, G. P.: Med. Clin. North Am., September, 1928, XII, 307.

(22) LAHEY, FRANK H., and JORDAN, SARA M.: Ann. Surg., February, 1928, LXXXVII, 231.

(23) HILL, FREDERICK C.: Med. Jour. and Rec., Feb. 16, 1927, CXXV, 258.

(24) LAMBRET, and RAZEMON, P.: Echo m. du nord, Aug. 24, 1929, XXXIII, 397.

(25) DICKSON, W. H.: Canadian Med. Assn. Jour., March, 1928, XVIII, 272.

(26) BOLTON, CHARLES, and TROTTER, WILFRED: British Med. Jour., June 5, 1920, I, 757.

(27) LION, G., and MOREAU, CH.: Rev. de Chir., May, 1909, XXXIX, 873.

# RIGHT DIAPHRAGMATIC HERNIA[1]

By M. J. GEYMAN, M.D., Roentgenologist, Santa Barbara Cottage Hospital, Santa Barbara, California

THE patient whose case report introduces this paper was a female 72 years of age, who was admitted to the hospital on Dr. Sansum's service, complaining of obesity, constipation, and rheumatism. Her history was negative for trauma. She had undergone a cholecystectomy at the age of 52 and had gone through nine normal pregnancies.

Physical examination showed dullness over the right lower chest, with absence of breath sounds over this area. During fluoroscopy incidental to an orthodiagram an enlarged heart was noted and a shadow seen in the right lower chest. She was referred to the Roentgen Department for chest study. This showed a moderate left ventricular enlargement, with a dense shadow in the lower half of the chest. The heart was displaced slightly to the left. No respiratory excursion could be seen on the right side. The upper zone of the shadow showed an air-containing viscus, and on the chance that this might represent gas-containing loops of bowel a barium meal was given to rule against a diaphragmatic anomaly (Fig. 1).

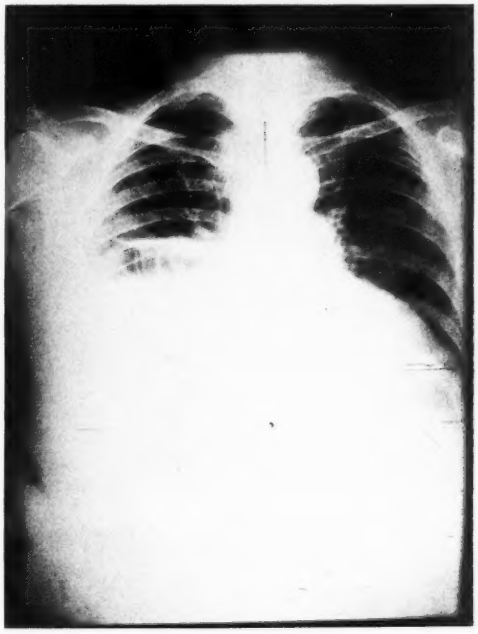


Fig. 1. Roentgenogram showing a high diaphragm and gas-filled loops of colon.

An intrinsically sound normal stomach and cap were visualized. The pyloric portion of the stomach and the duodenum were seen to be lower than the usual position in a patient of this habitus. The cap was large and flaccid, instead of being of the small round or flat type usually seen in stout patients (Fig. 2).

Twenty-four hours after the barium meal the head of the column was in the descending colon and the tail in the cecum. The entire hepatic flexure, including most of the transverse colon, was seen to lie in the right thorax, extending up to the level of the second rib anteriorly. Except for its position and a few diverticula, the colon was normal (Fig. 3). The tip of the cecum was seen to lie a few centimeters above the iliac crest. The ascending colon entered the thorax just to the right of the esophageal hiatus. No connection with this foramen could be observed either on films or by watching barium pass into the stomach while the colon still contained barium.

The heart film showed what was possibly a thin septum at the upper margin of the shadow, but films made after the colon was filled with barium failed to show evidence of this being the diaphragm. We concluded, therefore, that the wall of the colon, which contained a small amount of gas at

[1]Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1–5, 1930.

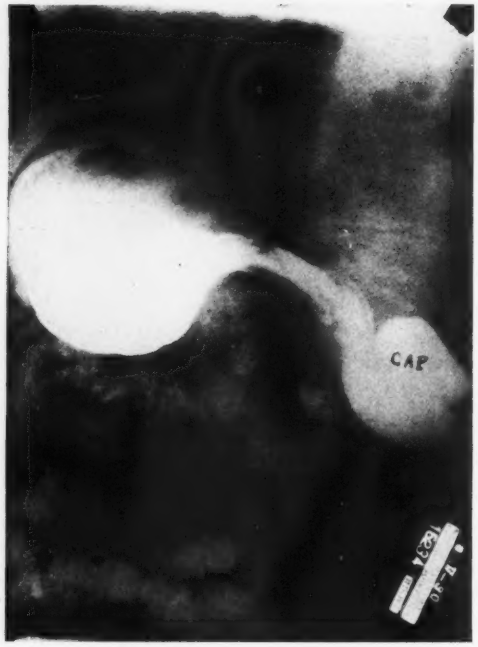



Fig. 2. Roentgenogram showing filled stomach and cap after the barium meal.

Fig. 3. Roentgenogram taken 24 hours after the barium meal, showing barium-filled colon in chest.

the first examination, accounted for this shadow. The condition was, therefore, regarded as a hernia rather than as an eventration of the diaphragm. Furthermore, the upper level of the shadow lacked the characteristic bow-shaped contour seen with eventration.

Anomalies of the diaphragm consist of eventration and hernia. In eventration, the diaphragm is abnormally high in level, due to either congenitally aplastic or acquired atrophic muscle fibers. Various writers have designated this condition by different terms, such as relaxation, insufficiency, high position, or dilation.

Hernia of the diaphragm is either congenital or traumatic in origin. Both hernia and eventration are seen much more commonly on the left side. Of various statistical summaries, Eppinger reports 626 left-sided hernias as compared to 8 on the right side. Thomas, in his review, found 8 right and 282 left. Twenty cases have been reported from the Mayo Clinic, 17 on the left side and 3 on the right.

Of a series of 17 cases reported by Carman and Fineman, one presents a remarkable similarity to the case I have just shown. Their patient was a woman 47 years old, who had suffered vague abdominal distress for years. They reported as follows: "A roentgenogram of the chest revealed gas bubbles above the right diaphragm and an opaque enema showed herniation of the colon through a large opening in the right diaphragm. At operation the transverse colon and omentum were found herniated into the chest. The hernial opening, 8.75 cm. in diameter, was found in the middle line posterior to the attachment of the diaphragm to the sternum. The patient's recovery was uneventful."

LeWald reported a very similar case in which operation showed the colon to enter the thorax behind the liver. In his case a

portion of the duodenum was above the diaphragm.

The type of case with herniation of the large bowel presents an entirely different picture from that of the right diaphragmatic hernia of the short esophageal type. Fineman, in describing a case, remarks that this type strongly simulates the appearance of walled-off fluid in the right lower chest.

The roentgen diagnosis of hernia or eventration of the diaphragm is not difficult if the condition is kept in mind during the routine examination of chest films and gastrointestinal cases. The differentiation between hernia and eventration is not so easy in some cases and may be impossible by the roentgen examination. Pneumoperitoneum may be useful as a differential aid if a barium series does not complete the necessary evidence. When, as was found in the case here reported, the upper zone of the shadow shows gas-containing loops of bowel, an absence of a bow-shaped diaphragmatic shadow, and the condition on the right side, the diagnosis of hernia can be made from chest films.

The literature contains reports of a considerable number of eventrations and hernias which have been explored with an aspirating needle. Truesdale reports one case where an exploratory chest puncture showed milk which the patient had drunk a short time before. The danger of this error is obvious and such errors can be avoided if the possibility of diaphragmatic anomaly is kept in mind.

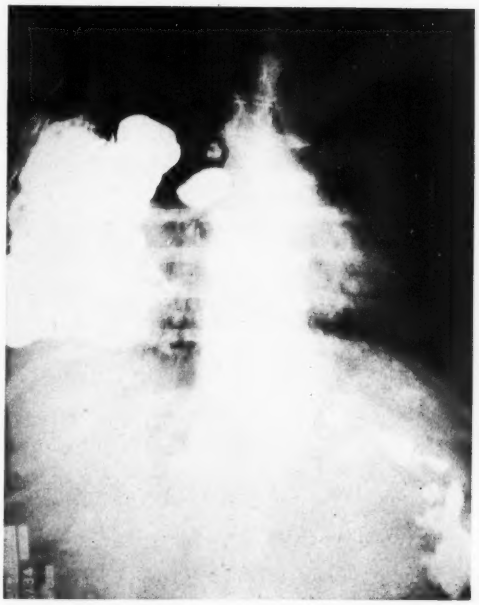


Fig. 4. Roentgenogram taken 48 hours after the barium meal.

## BIBLIOGRAPHY


1. Akerlund, Ake: Hernia Diaphragmatica Hiatus Œsophagei vom Anatomischen und Röntgenologischen Gesichtspunkt. Acta Radiologica, 1926, VI, 3.
2. Assmann, Herbert: Die klinische Röntgendiagnostik der inneren Erkankungen. Vogel, Leipzig, pp. 432-440.
3. Carman, Russell D., and Fineman, Solomon: Diaphragmatic Hernia, with Report of 17 Cases. Radiology, July, 1924, III, 26.
4. Cunningham, L. W.: and Shaw, W. McL.: Eventration and Hernia of the Diaphragm, with Report of Three Cases. Jour. Florida Med. Assn., July, 1924, XI, 7.
5. Fineman, Solomon, and Conner, H. Milton: Right Diaphragmatic Hernia of the Short Esophagus Type. Am. Jour. Med. Sci., May, 1924, CLXVII, 672.
6. Jenkinson, Edward L.: Lesions of the Diaphragm. Am. Jour. Roentgenol. and Rad. Ther., July, 1925, XIV, 16.
7. LeWald, Leon T.: Thoracic Stomach: Differentiation from Eventration and Hernia of the Diaphragm. Radiology, August, 1924, III, 91.
8. Truesdale, P. E.: Diaphragmatic Hernia: Its Clinical Aspects from Trauma in Children. Jour. Am. Med. Assn., Sept. 24, 1921, LXXVII, 993.
9. Uspensky: Die Röntgendiagnostik der Erkrankungen der Rechten Zwerchfellkuppe. Fortschr. a. d. Geb. d. Röntgenstr., XXXIII, 845.
10. Zwicker, A.: Ein Fall von Hernia diaphragmatica dextra hepatis nebst Beispielen zur Differentialdiagnose. Fortschr. a. d. Geb. d. Röntgenstr., 1929, XL, 51.

# A NEW DIAPHRAGM FOR THE COMPLETE ELIMINATION OF SECONDARY RADIATION

By A. L. SORESI, M.D., Visiting Surgeon, Greenpoint Hospital; Consulting Surgeon, Bushwick Hospital; Visiting Surgeon, Parkway Hospital, BROOKLYN, N. Y.

THE abolition of secondary radiation has been one of the most perplexing problems confronting radiologists. The Bucky-Potter diaphragm, notwithstanding its great merits, solves only a few of the problems concerning elimination of secondary radiation. The limitations of the Bucky-Potter diaphragm are so well known to roentgenologists that we do not even attempt to mention them.

The writer wishes to present a new diaphragm, the usefulness of which is not limited to any special technic, but which can be used for every purpose in all kinds of radiographic or radioscopic investigation, fulfilling all the desiderata of the radi-

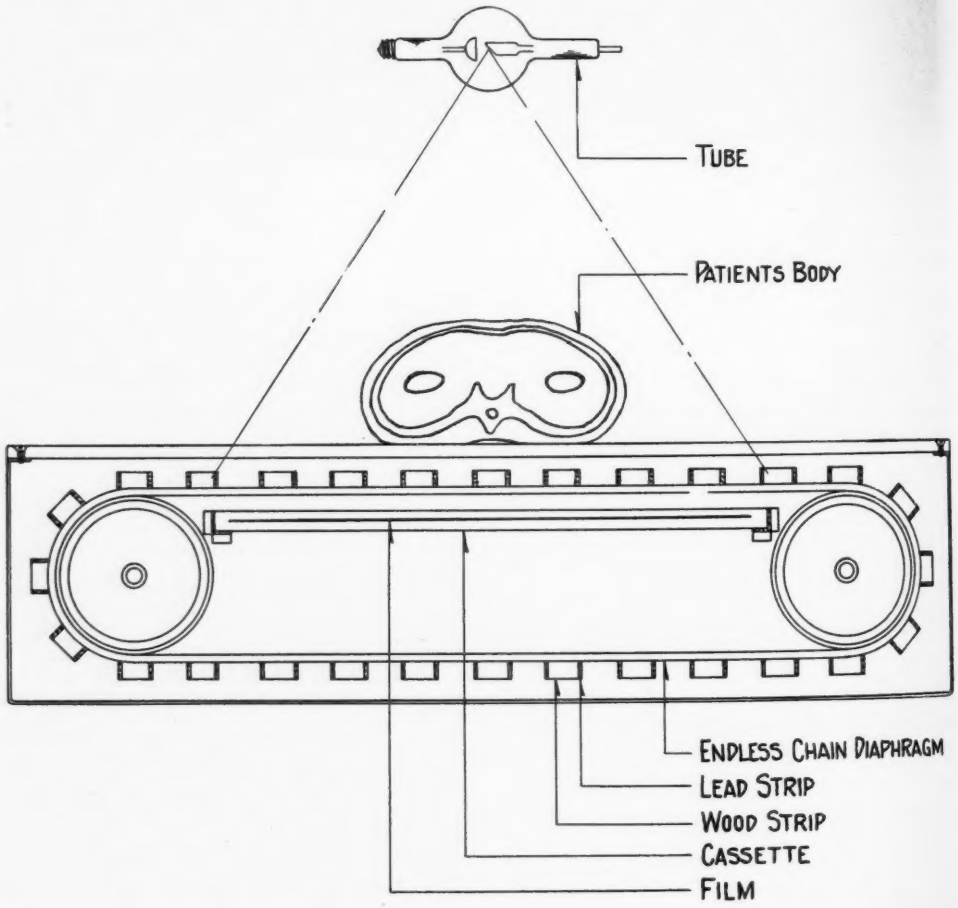
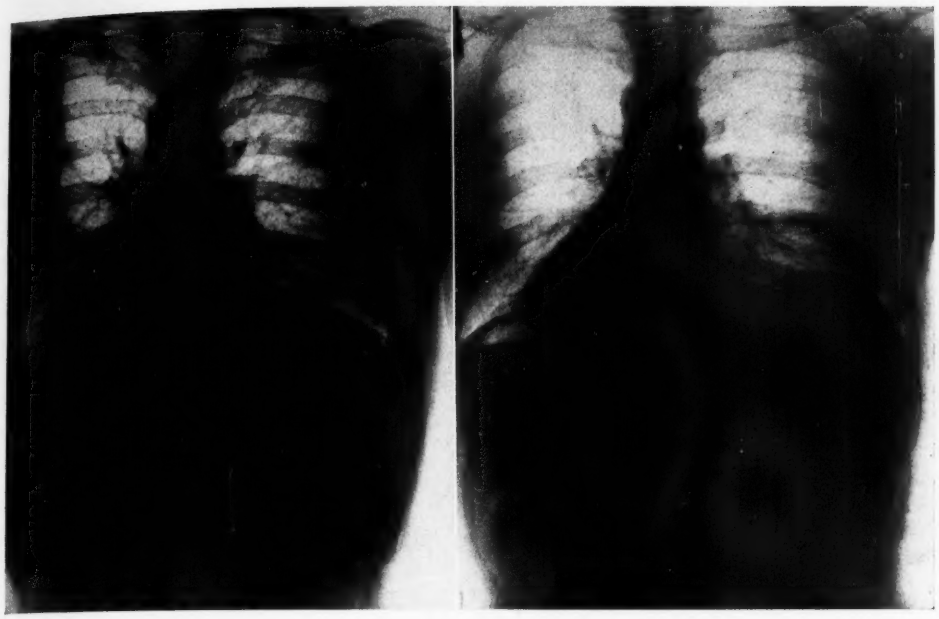



Fig. 1. Drawing of Soresi diaphragm.



Figs. 2 and 3. Chest of a heavy man. Both films were taken at 2 meters, one-tenth of a second exposure, with the same cassette. They were developed at the same time. All radiographic factors were exactly alike in these films, except that Figure 2 was taken with the Soresi diaphragm and Figure 3 without a diaphragm.

ologist. The author's diaphragm has the following characteristics:

1. It eliminates effectively secondary radiation.
2. It does not increase the time of exposure.
3. It can be used at any focal distance.
4. It allows the taking of radiographs at any speed with a sharpness of detail hitherto unknown.
5. It does not leave grid marks on any part of the film.
6. It is used also for fluoroscopy, making this procedure more useful by clearing considerably the image on the fluorescent screen.
7. It works independently from the X-ray tube.
8. It makes soft tissues very clear and distinct.
9. It works in any position.

Fig. 4. Radiograph of a young woman, 27 years of age, with goiter; normal trachea.

Fig. 5. Carcinoma of larynx, extending to trachea. Note infiltration of tissues revealed by the X-rays. Distance, 72 inches; time, one-tenth of a second.

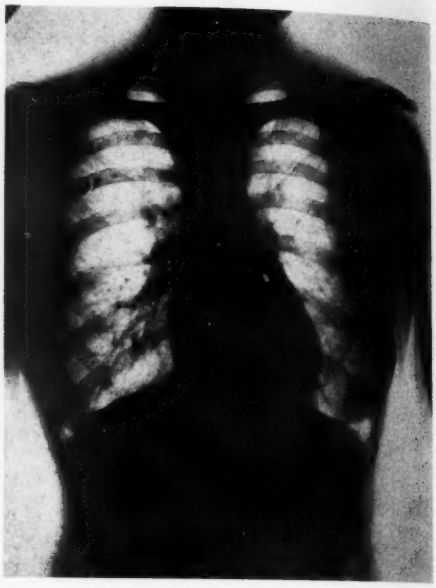


Fig. 6. Chest, at 72 inches; exposure, one-tenth of a second.

10. It can be used for all kinds of radiographic or fluoroscopic work.

We shall not enter into details of construction, which may vary with further experience and the requirements of manufacturing.

The fundamental principles on which our diaphragm is based are: (1) the lead strips are not parallel to the rays emitted by the tube; (2) the lead strips move at a tremendous speed independently of the X-ray tube; (3) the high speed at which the diaphragm moves is made possible by arranging the lead strips on an endless chain put in motion by a suitable electric motor. Physicists and radiologists may look upon these claims with skepticism. In fact, in discussing the conception of this diaphragm with leading men, nothing but the words "impossible," "contrary to physical principles," *et similia* were heard. However, skepticism was turned to praise, at times even above merits, when the diaphragm was demonstrated in actual radiography and radioscopy.

The writer's diaphragm works with absolute independence of the X-ray tube. It is set in motion, whether for fluoroscopy or radiography, and the current is passed through the tube when and as long as desired independently, and is timed by the usual apparatus.

The *modus operandi* is simplicity itself: films are placed in a channel located behind the diaphragm, which is then set in motion. The exposure is made by pressing the button of the timer, as is done when exposures are made at present without a diaphragm, the timer alone controlling the time of exposure.

### FOR FLUOROSCOPY

The fluorescent screen is applied against the cover protecting the lead strips, the patient being in front. The diaphragm is set

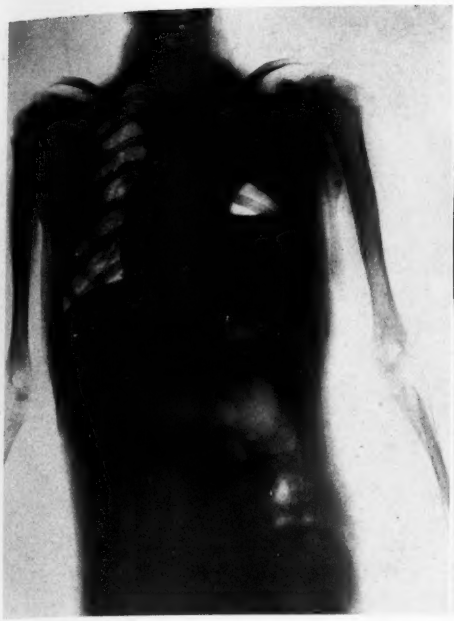


Fig. 7. Chest of a child, 6 years old, with pneumo- and pyo-thorax, at 72 inches; exposure, one-twentieth of a second.

Fig. 8. Carcinoma of esophagus in the middle third. Note how the tissues infiltrated by malignant cells stand out clearly. As in all other illustrations, the reproductions must of necessity fail to give the richness of detail shown in the original films. Distance, 72 inches; time, one-tenth of a second.

in motion and the current passed through the tube in the ordinary manner. Observation on the fluorescent screen is made through the double layer of lead strips and is exceedingly clear.

Special apparatus is in process of construction for combined fluoroscopy and radiography.

We have taken films of the digestive organs (stomach, gall bladder, colon, liver, spleen) all on one film, at about forty-five inches in three-tenths of a second, and of the chest, trachea, and esophagus, at seventy-two inches in one-twentieth of a second. Some of the radiographs are reproduced as illustrations in this paper, though it is an understood fact that reproductions fail to give the true impression one receives from the original films. The films taken with this diaphragm have a brightness and a lively character, lacking in films taken without the diaphragm described. Special mention should be made of soft-tissue revelation. The trachea, the epiglottis, the contour of tumors of the esophagus through the mediastinum, hairs, as well as silk and linen tissues and threads become plainly visible on the film.

We believe that this new diaphragm has a broad field of usefulness. The fact that it does not increase the time of exposure makes possible the elimination of secondary radiation on instantaneous films, thus giving them a most remarkable clearness of detail. The fact that it can be used at any focal distance allows elimination of secondary radiation on films at any focal distance, thus allowing clearer films of the chest at 72 inches or of the dense abdominal organs at 30 inches. The fact that it does not increase

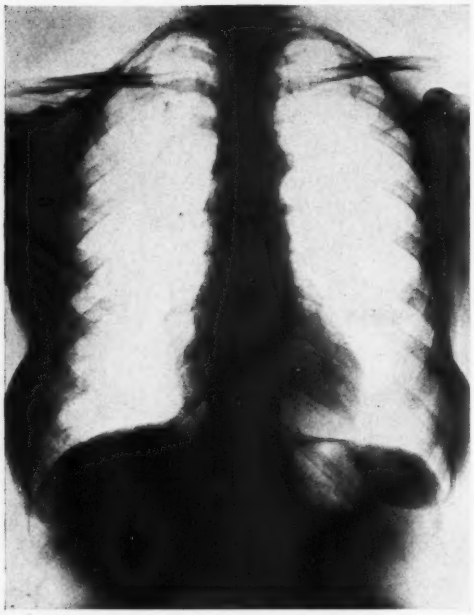


Fig. 9. Same case as shown in Figure 8, antero-posterior view. Note how the growth is shown through the mediastinum. Distance, 72 inches; exposure, one-tenth of a second.

Fig. 10. Skull taken at 72 inches; exposure, one-twentieth of a second.

Fig. 11. Gall bladder and colon taken at 40 inches; exposure, four-tenths of a second. In the original film the spleen, the liver, and the right kidney are plainly visible.

Fig. 12. Same case as shown in Figure 11, with the barium meal in the stomach.

the time of exposure makes radiography and radioscopy safer for patients, attendants, and tubes.

In conclusion, the writer hopes that the rapidly moving diaphragm herein described, with its unique features of abolishing secondary radiation while not increasing the time of exposure; its adaptability to any focal distance, to any speed, to any position, to both radiography and fluoroscopy, will be of help to radiologists.

The writer wishes to acknowledge the intelligent co-operation of the staff of the Westinghouse X-ray Co., Inc., and especially of Mr. Wappler, Mr. Fayer, and Mr. Larson.

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**The Relationship between Radiology and Medicine. Wright Clarkson. Virginia Med. Monthly, August, 1930, LVII, 298.**

The value of roentgen diagnosis is so striking that hundreds of physicians are succumbing to the lure of the manufacturers and are buying X-ray equipment without an adequate conception of the science of radiology. No branch of medical science requires more profound and prolonged study to master than that of radiology, because it extends into every phase of medicine, and the radiologist becomes a consultant in every specialty of practice. Most radiologists have no patients of their own but work purely as consultants, and as such should help correlate their findings with the clinical history and other data in actual consultation with the referring physicians or surgeons.

W. W. WATKINS, M.D.

**Sources of Danger in Superficial Therapy. Dezsö v. Kémeri. Strahlentherapie, 1930, XXXVIII, 187.**

The author observed that inaccurate readings of the milliamperemeter are quite common, due to electrostatic changes. The moisture of the room has great influence on this phenomenon. It appears that at a room temperature of from 15 to 20 degrees centigrade, a drop of the hygrometer from 40 to 35 degrees may lead to a difference in the dose up to 120 per cent. This fact should be considered more carefully in medico-legal cases.

ERNST A. POHLE, M.D., Ph.D.

# THE POST-OPERATIVE BEHAVIOR OF THE DIAPHRAGM[1]

By KENNETH D. A. ALLEN, M.D., DENVER, COLORADO

From the X-ray Department of the Presbyterian Hospital, Denver

SIX months ago it was determined to investigate some phases of post-operative chest complications by means of X-ray examination. The practice of making bedside X-ray examinations before and after operation was begun.

To date, the series of cases which have been radiated includes high and low abdominal operations, herniotomies, kidney operations, thyroid operations, perineal repair, curettements, hemorrhoidectomies, one submucous resection, two cases of radium applied to the cervix uteri, breast amputations, and operations upon the feet.

The anesthetics given to this group included local, spinal, rectal, ethylene, nitrous oxide and oxygen, and ether. Primarily the search was intended to be made for unsuspected atelectasis, and, in spite of the fact that our series of examinations thus far has been accomplished in the late Spring, Summer, and early Fall months, during which seasons chest complications are at a minimum in Colorado, we have found a considerable number of cases of atelectasis which would have passed unrecognized. The

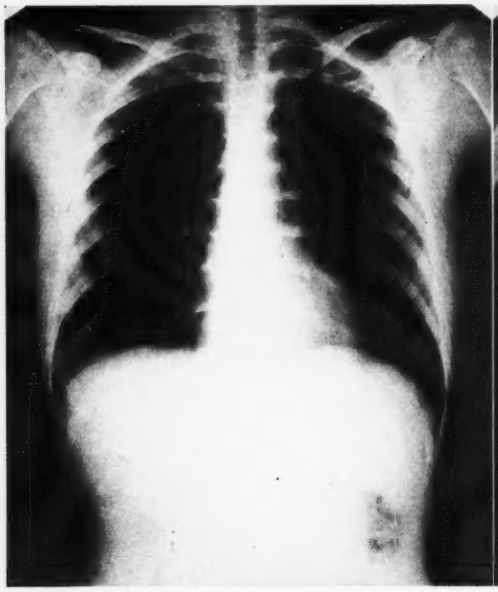

Fig. 1-*A*. Demonstration of effect of variation of technic in the level of the diaphragmatic domes. Bedside patient. Back flat on cassette. Cf. Fig. 1-*B*.

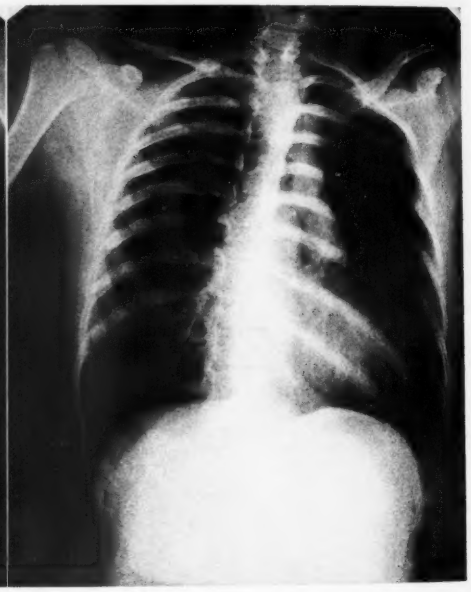

Fig. 1-*B*. Same case as shown in Figure 1-*A*. Right side purposely rotated forward to a marked degree. Tube-to-plate relationship remains the same. This "error" in technic does not affect the relative height of the domes of the diaphragm.

[1]Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1–5, 1930.

study will continue throughout the Winter and early Spring (17).

Many other interesting types of unsuspected chronic and acute chest pathology have been revealed in the series. These will be described in another paper.

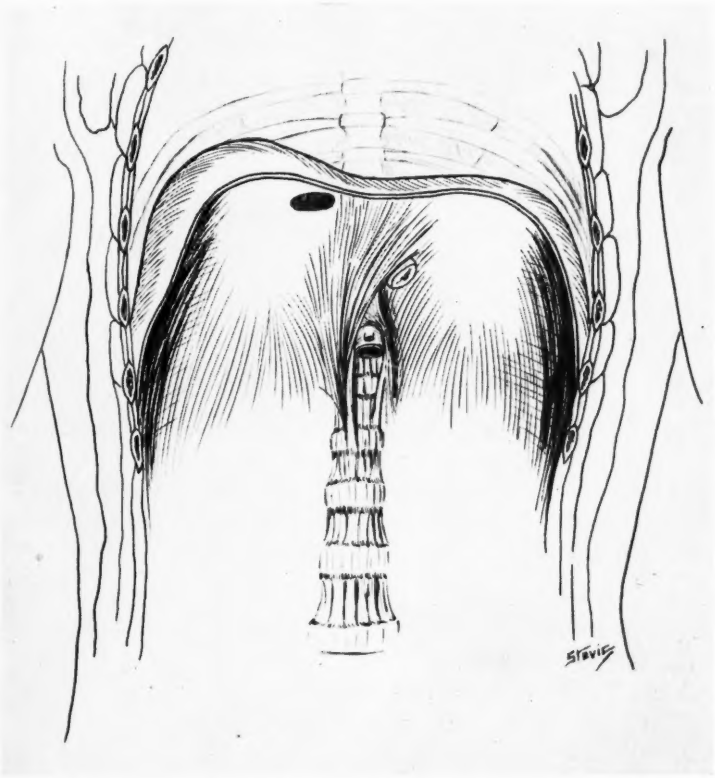


Fig. 2. Under surface and cut anterior edge of the diaphragm. Note how much lower the origin is than the insertion (central tendon in the dome). See text.

Early in the study it was noticed that in many instances (54 out of 94 cases) both diaphragm domes maintained a higher position immediately after than before operation. It was not long after this condition had manifested itself that an occasional case presented an asymmetrical relationship between the shape and position of the two hemidiaphragms after operation, when compared to their relative shape and position before operation. (See Figs. 8-*A*, 8-*B*, 9-*A*, 9-*B*, 9-*C*, 10-*A*, and 10-*B*.)

This paper will confine itself essentially to that portion of the study which deals with the post-operative asymmetry of the diaphragmatic domes. A consideration of the relationship of this condition to atelectasis by the writer of this article may be found in a previous paper on the subject of post-operative chest complications (9).

Thirty-six cases out of 94 (the total number studied to date) have shown a sharp arching and high position of the right hemidiaphragm, and five cases have shown a

Fig. 3-*A*. Pre-operative X-ray examination. Cf. Fig. 3-*B*.

Fig. 3-*B*. Two days post-operative examination of same (low abdominal) case as shown in Figure 3-*A*, made at full inspiration. Both domes are high, with superimposed additional ascent of the right hemidiaphragm. The heart is forced to a horizontal position, extending more to the right of the spine than in the pre-operative plate. Collateral lung clear. See text.

similar situation of the left half of the diaphragm, with no X-ray or clinical evidence of disease of the collateral lung.

The affected hemidiaphragm is found to have assumed a high position when examined the day after operation, and as a rule it gradually subsides to the pre-operative position and shape when visualized at inspiration by the same technic as at the first examination, in a week or ten days. In some instances the affected dome was still high three weeks later. A few have subsided markedly in three or four days.

Many cases show both hemidiaphragms to be high after operation, with one asymmetrically higher than the other. This causes the heart to assume a more horizontal position and thus may cause it to encroach farther on the side of the higher diaphragm than it did in the pre-operative plate. This combination gives a strong impression of atelectasis, and it was at first thought that these findings, in the absence of visualized density of the lung, were the result of an atelectasis which, perhaps, was obscured behind the dome in the posterior sulcus, but lateral X-ray plates and close clinical observation have disproved that conception. Brunn and Brill (15) illustrate a paper[2] with a typical case of asymmetrically high hemidiaphragm which they attribute to a minor degree of atelectasis, yet the lung field is clear. Our series of cases have led to the belief that this condition may precede and contribute to atelectasis.

After this phenomenon had been repeated in several patients, the recent literature was reviewed and reference found to a symmetrically high position of both diaphragmatic domes following abdominal operations

[2]This article was noted just prior to the final typing of this paper.

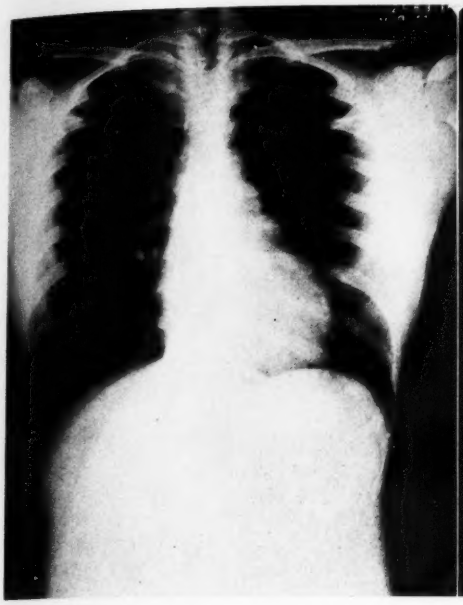

Fig. 4-*A*. Pre-operative plate of a nephropexy case. Cf. Fig. 4-*B*.

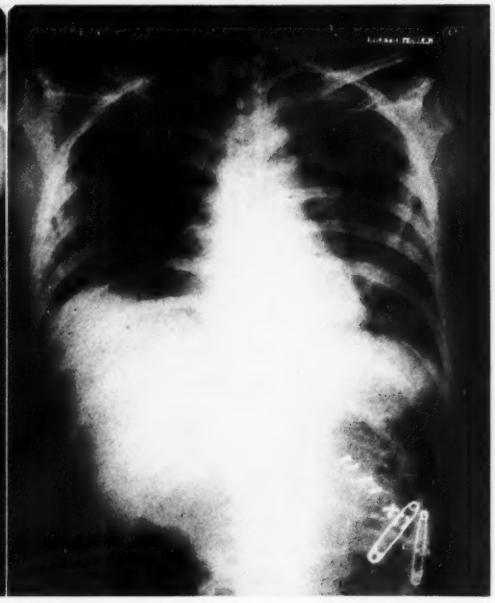

Fig. 4-*B*. Same case as shown in Figure 4-*A*, two days post-operative. Not only is the right hemidiaphragm high with no evidence of atelectasis above, but there is marked bilateral ascent of both diaphragms with hypoventilation of both lungs. Note left kidney incision clips and large amount of abdominal gas. See text.

(5, 8) in several smaller series of cases, but attention was not called to a high position of one side only. The nearest approach to a mention of this condition, except as a sign of atelectasis, which I have found was by Sise, Mason, and Bogan (12). They state that ten cases of gall-bladder surgery radiated before and after operation showed a marked diminution of *excursion* in both leaves of the diaphragm, with the greater effect on the right.

We concur with Muller (7) that the bilateral post-operative high position of the diaphragm can possibly be explained without much consideration of hypotonus, paresis, or partial paralysis. The one-sided high position, however, seems to require serious consideration of possible nerve inhibition or paralysis of varying degree.

Most chest complications, especially atelectasis, occur unilaterally, and more on the right side than on the left, and more often in the lower lobe than in the upper. The high diaphragm finding occurs much more often on the right, and would, of course, have more effect on the lower lobes than on the upper lobes.

Because of these considerations the subject is deemed sufficiently important to warrant the presentation of our observations thus far and the venture of interpretation. It therefore becomes the purpose of this paper to describe and interpret these X-ray manifestations and to allude to the cause, hoping that a little evidence may be added to the rapidly accumulating data on the subject of post-operative chest complications.

## RADIOGRAPHIC TECHNIC

Because we were studying the difference in the relative position of the two diaphragmatic domes, and not the position of

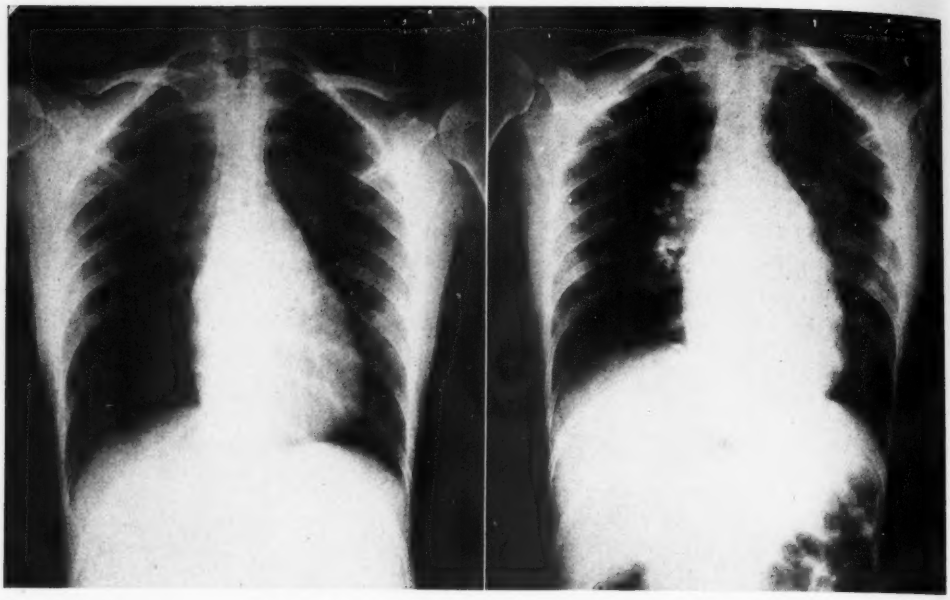

Fig. 5-*A*. Pre-operative chest roentgenogram. Cf. Fig. 5-*B*.

Fig. 5-*B*. Same case as shown in Figure 5-*A*. Some asymmetrical ascent of the right hemidiaphragm. Note that air admitted by abdominal operation has sought only the right subdiaphragmatic area. See text. Note also the sharper outline of the high dome as compared with the opposite side and the same dome prior to operation.

either one as measured from a bony landmark, variance in the target-to-plate distance and angle at which the patient was raised made no appreciable difference in the findings. This was demonstrated by making two or more examinations on the same patient, each with different technic. Even when the patient was turned with one side farther from the plate than the other, the diaphragmatic domes were not changed in their relative height (Figs. 1-*A* and 1-*B*).

Some of the earlier cases of the series were examined pre-operatively at the erect chest plate changer, followed by post-operative bedside plates. This did not interfere with the results in any case. The majority of the cases, however, were radiated in bed with exactly the same technic before and after operation, the beds being brought to the radiographic room. The central ray was passed through the ensiform at right-angles to the plate, 46-inch distance, 100 milliamperes, one-tenth second, and the kilovoltage variable. Every effort was made to reproduce after operation the technic employed before. All patients were asked to take as deep a breath as possible and hold it during the exposure.

We hope as we continue our study to make more examinations in the lateral position. They are valuable to other phases of the work but probably will not add much evidence to the problem discussed in this paper.

## ANATOMY

A glance at Figure 2 to refresh our memory of the anatomy (1) of the diaphragm, reveals that its origin, which is on the lower five or six ribs, upper three or four lumbar vertebræ and ensiform, is lower than the insertion, namely, the central tendon

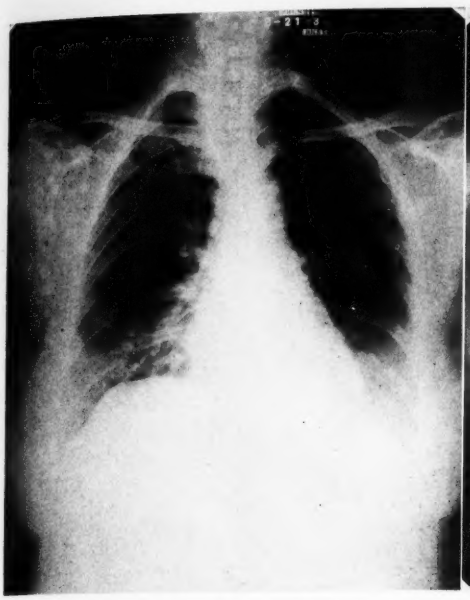

Fig. 6-*A*. Pre-operative roentgenogram (exposure too light to penetrate breast shadows and bases). Cf. Fig. 6-*B*.

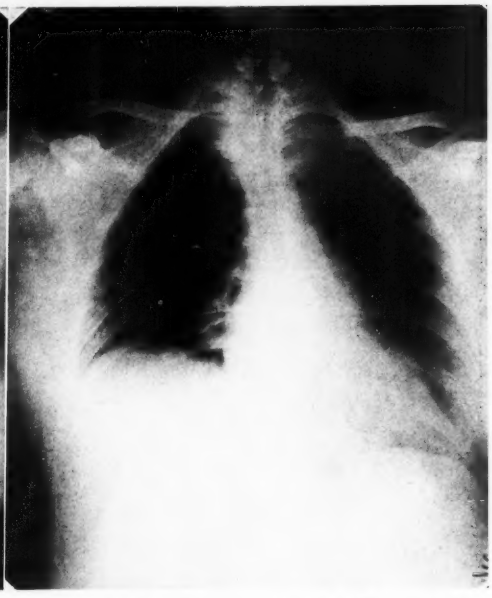

Fig. 6-*B*. Same case as shown in Figure 6-*A*, one day post-operative. Note change in relative position of the domes of the diaphragm with no demonstrable right lung disease. Note narrowed interspaces on the right. See text.

which is practically the highest part of each hemidiaphragm. Contraction must cause the arched dome to descend and flatten. Relaxation or paralysis permits ascension and arching. This is demonstrated physiologically by inspiration (contraction) and expiration (relaxation), respectively. This fact is further demonstrated, pathologically, after the operation of phrenico-exeresis.

The diaphragm is merely a thin membrane-like partition fastened loosely across the thoraco-abdominal cavity. Atmospheric pressure on the flaccid-walled abdominal portion of the cavity keeps the thin hemidiaphragms ballooned upward into the rigid-walled thoracic cavity (3). Contraction works against this abdominal pressure and causes flattening and descent of the domes: relaxation permits them to passively ascend and arch.

## DISCUSSION

It is logical to believe that the more constant post-operative findings of bilateral high position of both hemidiaphragms and the less common phenomenon of one dome arching to a higher position after operation than its position relative to the opposite dome before operation, are not existent from the same causes.

Two main causes of the bilateral symmetrically raised diaphragm present themselves. The first to be thought of is that pain occasioned by deep breathing will prevent the patient from inspiring as fully after operation as before. The other most tenable cause is an increase of intra-abdominal pressure, caused by accumulating gas, which forces both domes upward. (See Figs. 3-*A* and 3-*B*.)

Abdominal and many other major operations are attended with post-operative pain when the patient inspires deeply (6). This prevents him from taking as deep a breath when radiated after operation as at

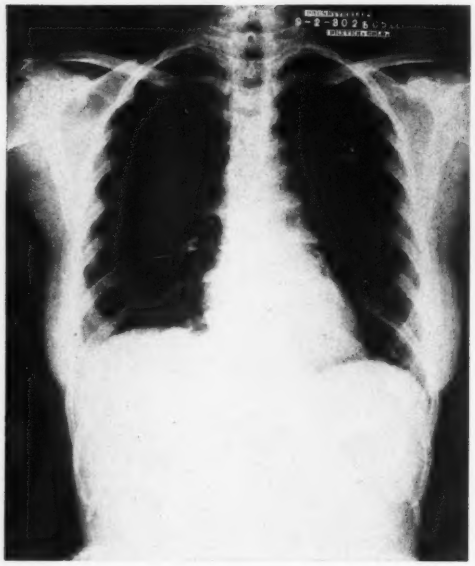

Fig. 7-*A*. Pre-operative X-ray examination. Right hemidiaphragm normally a little above the left one. Cf. Figs. 7-*B* and 7-*C*.

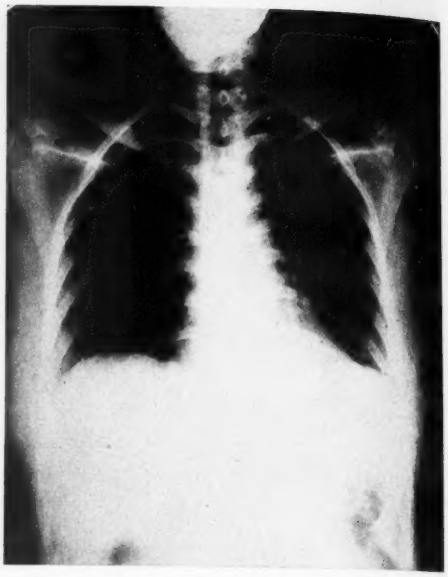

Fig. 7-*B*. Same case as shown in Figure 7-*A*, two days post-operative. Note that the domes are now of equal height, probably indicating asymmetrical ascent of the left hemidiaphragm. Cf. Fig. 7-*C*.

his X-ray examination prior to operation. Table I exhibits statistics which strengthen this opinion. It will be noted that abdominal operations, kidney operations, perineal repair, and thyroidectomies show the highest incidence of bilateral raising of the dia-

TABLE I

OCCURRENCE OF ASYMMETRICAL HIGH HEMIDIAPHRAGM NOTING ALSO NUMBER OF BILATERAL CASES

| Type of operation | No. of cases | Unilateral high diaphragm | | No. of cases of bilateral ascent of diaphragm |
|---|---|---|---|---|
| | | No. of cases | Percentage | |
| Herniotomy | 4 | 3 (all right) | 75% | 2 |
| High abdominal | 13 | 9 (8 right; 1 left) | 61% | 8 |
| Kidney | 10 | 6 (5 right; 1 left) | 60% | 7 |
| Low abdominal | 34 | 12 (11 right; 1 left) | 47% | 16 |
| Uterine curettage | 5 | 2 (1 right; 1 left) | 40% | 0 |
| Hemorrhoid | 3 | 1 (right) | 33% | 0 |
| Thyroid | 15 | 3 (2 right; 1 left) | 20% | 7 |
| Breast (amputation) | 3 | 0 | 0% | 0 |
| Perineal | 2 | 0 | 0% | 2 |
| Foot operations | 3 | 0 | 0% | 1 |
| Radium to cervix | 2 | 0 | 0% | 0 |
| Submucous resection | 1 | 0 | 0% | 0 |

phragm following operation. These types of operative procedures cause the most post-operative pain upon deep breathing.

Patey (6), Head (8), and Oberholt (16)[3] measured the vital capacity (the total volume of air obtained from a maximum expiration following a maximum inspiration) before and after abdominal and other operations. Following operation there was a smaller vital capacity than before. The abdominal operations caused the greatest discrepancy.

Evidence upholding the abdominal gas factor as a cause was found in a study of serial X-ray examinations of new born infants[4] beginning immediately at birth with plates, made at varying intervals up to ten days, on file with the Child Research Council of the University of Colorado Medical School. It was noted that as air was ingested first into the stomach and then into the small and large intestine, the hemidiaphragms gradually ascended in relation to the increase in the amount of air and fermentative gas. Unilateral disposition of the gas caused symmetrical upward displacement of both sides of the diaphragm. In none of the cases reviewed was there an asymmetrical upward displacement of the diaphragm. Further evidence supporting abdominal gas as a cause of bilateral symmetrical raising of the diaphragm is furnished by some adult cases in our present series, which show one-sided accumulation of gas (Figs. 3-*A* and 3-*B*) accompanied by a symmetrically high diaphragm.

Pressure in the abdomen apparently follows the law of pressure on liquids, namely, that it is exerted equally in all directions. This is graphically demonstrated in the paradoxical movement with respiration of a phrenicectomized hemidiaphragm. Pressure downward on the abdominal contents by the

Fig. 7-*C*. Same case as shown in Figures 7-*A* and 7-*B*, fifteen days post-operative. Right hemidiaphragm again higher than left, as in the pre-operative plate. Left dome has subsided.

normal side is transmitted as though by a liquid medium to the passive side.

Muscle splinting in abdominal cases may exaggerate the pressure caused by the increasing gas.

The presence of bilateral paralysis as a cause is obviated by the lack of symptoms. Whereas paralysis of one hemidiaphragm may have very slight symptomatology because, as Andrus and Wilson (11) tell us, there is reduction of only one-sixth to one-third of tidal air rate and respiratory volume, which is quickly compensated for by the other lung, bilateral paralysis, on the other hand, reduces tidal air volume by 60 per cent and respiratory volume by 62 per cent. The bilateral high diaphragm was found in too many cases of uneventful and symptomless recovery to permit of suspecting paralysis as a cause even in degrees less than complete.

The statistics of our series further indicate that the causes of unilateral rise are

[3]Published after this paper had been typed.

[4]The writer wishes to thank Dr. W. W. Wasson for the suggestion that he review these cases.

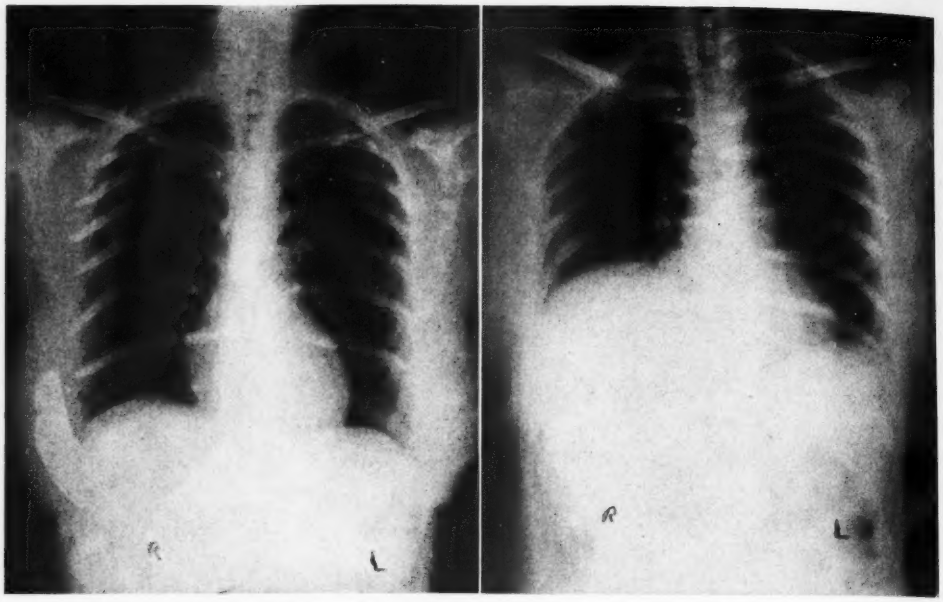

Fig. 8-*A*. Pre-operative plate. Cf. Fig. 8-*B*.

Fig. 8-*B*. Same case as shown in Figure 8-*A*, one day post-operative. No density indicating atelectasis of sufficient extent to require this much diaphragmatic ascent. No clinical indication of lung pathology.

different from those of bilateral high position. There were at least eight of the former not accompanied by the latter condition and at least ten of the latter type of cases not accompanied by asymmetrical high diaphragm.

Explanation of the high position, following operation, of *one* diaphragmatic dome is not so manifest. Thus far we have been unable to evolve an explanation without resorting to the idea of at least a partial paralysis.

After studying the ninety-four cases in this group there can be no doubt but that in a certain number of operative cases one dome of the diaphragm assumes an abnormally high position *in relation to the opposite dome*, without X-ray or clinical evidence of collateral lung disease.

Each case has been carefully measured to establish the relative position of the two domes. Unless a change of 1 cm. or more was present, the case was not included in the statistics. In many cases of one-sided post-operative rise, the opposite dome had also mounted after operation by virtue of the causes of bilateral post-operative rise, so that most of the measurements of one-sided ascent of from 1 cm. to 4.5 cm. are in excess of the bilateral ascent, which apparently varied from 1 to 4 centimeters. (See Figs. 4-*A* and 4-*B*.) (Error in measurement of the ascent of both diaphragms in relation to the spine or other bony landmark could be caused by variation of technic; therefore, the figures of these measurements are not presented.)

Asymmetrical action of the diaphragm precludes all possibility of voluntary restriction, and the cause will probably be most fruitfully searched for in the realm of the pathological. So far, we have no experimental data to help us determine the fundamental etiology of this condition and we

must be content at this time to present our observations and advance a discussion of the cause from the basis of clinical reasoning. From the evidence thus far accumulated, interference of the motor nerve impulses to the affected hemidiaphragm is the most tenable etiological theory of this phenomenon which takes place in the short interval between the day previous to operation and the day after.

Anatomical muscular weakness has been suggested. Anatomical defects are more common on the left. The "high diaphragm" of this series is predominantly on the right side. Furthermore, it is hard to believe that 43 per cent of individuals have such a degree of one-sided muscular weakness, which is symptomless and not evident by X-ray examination before operation, that it would permit upward displacement of a hemidiaphragm to the extent seen in our series. Autopsies show no gross organic evidence of such a high percentage of malformation.

Engorgement of the liver would cause bilateral diaphragmatic rise because of its mobility. It moves up and down readily with respiration by virtue of the contractions of the diaphragm, and, therefore, a properly functioning right dome would exert sufficient restraint to an enlarged liver to cause it to press down into the abdominal contents, and thus, increasing intra-abdominal pressure, exert equal upward force on both sides of the diaphragm.

The X-ray plates themselves, as has been stated, rule out lung pathology as a cause of this condition. Those cases which exhibited sufficient atelectasis to require diaphragmatic upward displacement to compensate for the absorbed air have been excluded from this series.

Further evidence favoring interference with the motor nerve supply as the most important underlying factor, is presented by the fact that a considerable number of the

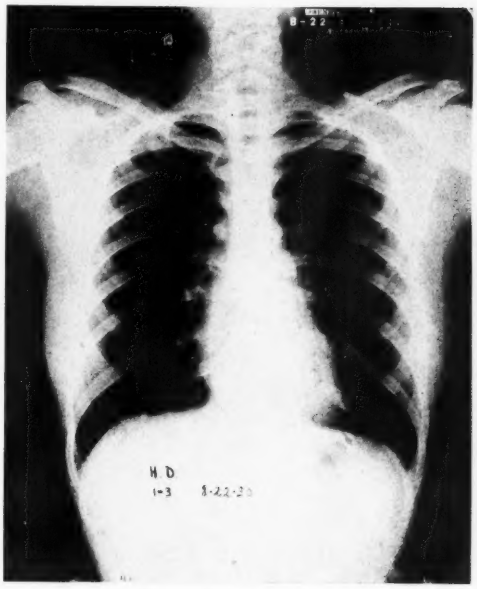

Fig. 9-*A*. Pre-operative X-ray examination. Cf. Figs. 9-*B* and 9-*C*.

high diaphragms show a higher arching with a sharper outline than the active opposite side and the same dome prior to operation (Figs. 5-*A* and 5-*B*). Radiographs of the diaphragm of normal persons show a sharper outline at expiration than inspiration because they are caught during the period of relaxation, a condition which is also made evident in plates following one-sided phrenicectomy. At inspiration a normal diaphragm tends to flatten, and, even though the patient does not breathe, there is often sufficient quivering of the contracted muscle to show a blurring of outline. This is demonstrated in longer exposures better than in those made in one-twentieth of a second. Comparison of the high and low halves in this series shows, in many cases, a blurring of the low dome and sharpness of the high one, presumably due to tonicity of the one and atonicity of the other. The high side undeniably approaches the shape, position, and sharpness of phrenicectomized hemidiaphragms, differing only in degree. This

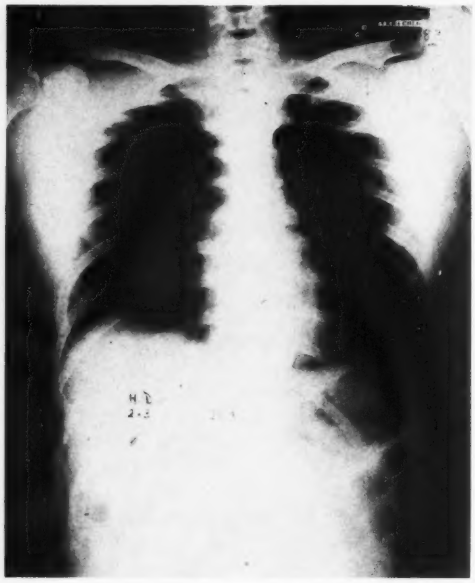

Fig. 9-*B*. Same case as shown in Figure 9-*A*, post-operative. Note the high right hemidiaphragm with clear lung above. Cf. Figs. 9-*A* and 9-*C*.

will be revealed by a study of the figures illustrating this article. Furthermore, in a few cases of high diaphragm, which we have radiated at inspiration and expiration, the unaffected dome travels farther than the affected one to a sufficiently greater extent than the average normal difference in the excursion of the two, to suggest the paradoxical action so characteristic of phrenicectomy.

The series of ten cases roentgenographed before and after gall-bladder operations of Sise and co-workers (12), previously mentioned, also exhibited inhibited excursion of the right hemidiaphragm in relation to the left half. Because neither half exhibits normal excursion following operation, the effect is not so dramatic as that following excision of a few centimeters of the phrenic nerve.

Observation of this series of cases reveals many instances of hypo-elevation of the ribs and lessening of the interspaces on the affected side (Figs. 6-*A* and 6-*B*). They should show an increased excursion and widened interspaces on inspiration in the presence of a hypofunctioning diaphragm (10). This is because: (1) the diaphragm no longer peels from the chest wall in the lateral sulcus region; (2) less intrapleural negative pressure exists, and (3) there is increased inspiration effort to compensate for the hypofunction of the hemidiaphragm. The cases of hemithoracic narrowing and rib depression show no X-ray evidence to the effect that there has been any blockage of pulmonary access to external atmospheric pressure, which situation is immediately manifested on the X-ray plate by marked densities (9), in which condition atmospheric pressure on the external chest wall causes depression of the entire hemithorax by virtue of the fact that the same pressure is removed from the inside.

We can, therefore, logically proffer the question of accessory respiratory muscle enervation. The proposition that the diaphragmatic disturbance is the result of motor nerve impulse inhibition is enhanced by the possibility of a similar condition affecting accessory inspiratory muscles, and *vice versa*.

### POSSIBLE CAUSES OF POST-OPERATIVE PARALYSIS OF ONE HEMIDIAPHRAGM

If temporary partial paralysis is the correct explanation of the observations described thus far, it is appropriate here to enumerate and briefly discuss some of the most tenable theories of etiology. None of the possible causes to be presented are irrefragable.

*Morphine.*—The administration of morphine does not appear to be responsible for the unilateral rise of the diaphragm. There is some evidence to suggest that it may increase the number of cases of bilateral high diaphragm and thus contribute to hypoventilation. A summary of the amount of mor-

TABLE II

RELATION OF AMOUNT OF MORPHINE ADMINISTERED BETWEEN OPERATION AND POST-OPERATIVE X-RAY EXAMINATION TO BILATERAL AND UNILATERAL HIGH DIAPHRAGM

| Position of diaphragm | No. of cases | Average total amount of morphine given each patient |
|---|---|---|
| High unilateral position | 33 | 59 mgm. |
| High bilateral position | 49 | 60 mgm. |
| Diaphragms not affected | 27 | 41 mgm. |

TABLE III

OCCURRENCE OF HIGH HEMIDIAPHRAGM IN RELATION TO ANESTHETICS

| Anesthetic | No. of cases | Case of high hemidiaphragm | |
|---|---|---|---|
| | | No. of cases | Percentage |
| Ether | 20 | 8 | 40% |
| Spinal, Rectal, and Local | 9 | 3 | 33% |
| Gas ($NO+O_2$ and Ethylene) | 66 | 21 | 32% |

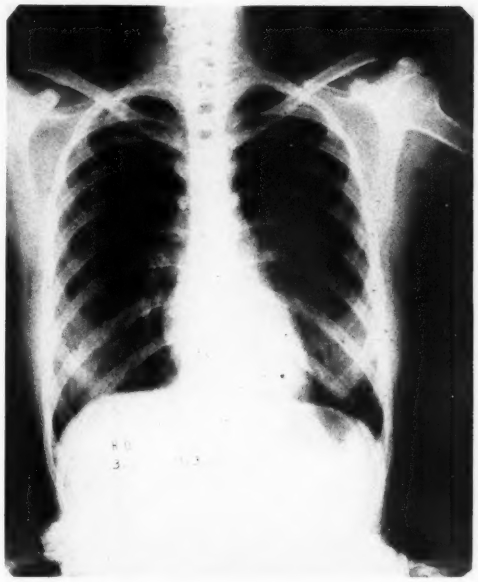

Fig. 9-*C*. Same case as shown in Figures 9-*A* and 9-*B*, three days after the latter. Diaphragm with domes again in normal relation.

phine administered between the time of operation and the post-operative X-ray examination reveals that forty-nine cases in which, after operation, both diaphragms failed to travel through the distance of the pre-operative inspiratory excursion, averaged 60 milligrams. (Table II). The average total dosage of twenty-seven cases in which neither diaphragm was affected was 41 milligrams. The appraisal of the value of this relationship must be made with the realization that the operative cases to which the smaller doses were given had the less extensive operations, and the causes of bilateral rise are present in a less severe degree. The average dose given to thirty-three cases of asymmetrical high diaphragm was 59 milligrams. This is practically the same amount as that administered to the bilateral series.

There was no series of cases which had no morphine, to compare with the series which received morphine, and therefore we believe that the only conclusion which is suggested, in addition to the one mentioned, is that asymmetrical high diaphragm differs from bilateral high diaphragm due to other causes than the administration of morphine.

*Anesthetics.*—There was a total of sixty-six gas anesthesias and twenty-one (or about 33 per cent) in this series showed high asymmetrical diaphragms (Table III).

Twenty of the series were given ether. Of this number, eight (or about 40 per cent) had an asymmetrically high diaphragm.

The total number of rectal, local, and spinal anesthesias numbered nine. Three of this number (or 33 per cent) had a high hemidiaphragm.

The series thus far, therefore, indicates that the type of anesthesia has little to do with the incidence of this condition. The slightly higher percentage of ether cases hardly warrants serious consideration.

Fig. 10-*A*. Pre-operative chest roentgenogram of thyroidectomy case. Exposure insufficient to penetrate breast shadows and bases. Cf. Fig. 10-*B*.

Fig. 10-*B*. Same case as shown in Figure 10-*A*, post-operative. High hemidiaphragm. Lung above clear. (Apparent mediastinal shift probably due to rotation of patient.) A little perihilum atelectasis cannot be entirely excluded. The density at the right apex is due to removal of substernal goiter. There is not sufficient atelectasis in any event to require so great an ascent of the diaphragm.

*Type of Operation.*—Table I indicates that there were sixteen cases of high hemidiaphragm out of a total of thirty-four low abdominal operations, and eight cases out of thirteen high abdominal operations. This shows a ratio of 47 per cent to 61 per cent, a difference which can hardly be ignored. Abdominal cases as a whole show 54 per cent to be affected by asymmetrical high diaphragm. A high incision in the abdomen apparently is more effective in producing this condition than the low incision.

Ten kidney operations, with flank incisions, showed six cases (or 60 per cent), closely approximating the high abdominal percentage. Four herniotomies showed three high diaphragms—a percentage of 75. The small number of these cases, however, precludes a definite opinion of the correct percentage. All three cases showed high *right* diaphragms. One had a midline incision (umbilical hernia), and the other two left-sided incisions (left inguinal). These cases, combined with two high left diaphragms (one of which is shown in Figures 7-*A*, 7-*B*, and 7-*C*), which occurred with right-sided incisions, and with numerous cases of midline incisions followed by right high diaphragm, strongly indicate that the position of the incision in relation to the right or left side in abdominal cases does not decide which half of the diaphragm will be affected.

All other operations, a list of which is shown in Table I, numbered thirty-four. Of this group, only six (17 per cent) had asymmetrically high diaphragm, indicating a much lower percentage than did abdominal, kidney, and herniotomy cases.

It is logical to conclude, therefore, that the type of operation has more effect than

either the type of anesthetic or the administration of morphine.

ENUMERATION OF OTHER POSSIBLE CAUSES

Thoughtful consideration of the possible causes of the phenomenon which is the subject of this paper points to the probability of a multiple etiology. When satisfactory explanation of intraperitoneal cases is evolved, the fact that the condition occurs in such cases as curettement and thyroidectomies confronts us. That the right diaphragm is affected so much more than the left, should be used as a fact to help determine the cause. Except for one suggestion, mentioned later, no likely single etiological factor for all cases has occurred to us, so we will be content to state different possible causes for different types of operation.

It has long been known that peritoneal cavity lymphatic drainage is much more active to the right hemidiaphragm than to the left (13), due to liver friction and undoubtedly to other causes. That the right subdiaphragmatic area is more easily reached from the intraperitoneal cavity is further suggested by an observation in our series; in all cases which showed residual air admitted through the incision, it was found under the right hemidiaphragm (Fig. 5-*B*). From the diaphragm the lymphatics drain upward by diagonal trunks to the sternum and anterior mediastinum along the *phrenic nerve* to the hilum region of the lung,—a few vessels go directly to the thoracic duct.

The abdominal cases of high hemidiaphragm, then, could be thought of as being caused by the effect of toxic traumatized protein carried to the right hemidiaphragm, and occasionally the left, where it is held, by disturbed absorption, in apposition to the phrenic nerve terminations, interfering with their conduction. Then after the toxins are finally absorbed they may produce an inflammatory reaction along the course of the phrenic nerve and perhaps even in the mediastinal lymph-node area. A "vicious circle" situation presents itself on the under surface of the diaphragm. We know that phrenicectomy retards absorption; thus after the first interference of conduction through the phrenic terminations which are spread out on the under side of the muscle, absorption is retarded and more time given for still further inhibitory effect on the nerve terminations.

Reflex effect on the phrenic nerve from impulses carried through the vagus warrants mention here.

If interference of function of the gastro-intestinal tract, not only by direct trauma but reflexly by the effect of the anesthetic and shock, causes a toxic material in the abdominal cavity to be liberated into the lymphatics and thence to the diaphragm, a possible cause of all cases is suggested. The smaller the operation and the more distant from the abdomen, the less the gastro-intestinal effect. The evidence of the cases listed in Table I strengthens this opinion.

We know that inflammation of the pleura above the diaphragm is often given as a cause for palsy of this organ and doubtless is the reason for its high arching in certain types of supradiaphragmatic disease. It is difficult, however, to conceive of a reason for a pleural inflammatory process in many of the types of surgical cases which have been followed by high hemidiaphragm, and it could hardly become effective in the short time between operation and post-operative X-ray examination.

General shock, with resulting phrenic nerve inhibition of cerebral origin, or the same result from cortical toxemia or lowered blood chlorides from intestinal stasis, must be included in our list of possible causes. This, however, suggests the question as to why the result should be unilateral. Some of our cases, of course, may have bilateral inhibition, which, because of the normal ex-

cess of excursion of the right hemidiaphragm, is manifested more on the right than on the left side, and therefore is not recognized as occurring on both sides.

Another consideration worthy of inclusion in this list is possible pressure on the phrenic nerve along its intrathoracic course. We know that long-continued pressure, such as that caused by effusions, empyema, tumors, and inflammatory processes of the mediastinum, may bring about phrenic nerve paralysis (14). Engorgement of the superior vena cava may also increase the mediastinal pressure on the phrenic nerve. The lessened abdominal pumping, because of the bilateral failure of the diaphragm to function fully after operation, upon the abdominal inferior vena cava might lend to this condition.

It is conceivable that cardiac dilatation could cause stretching of or pressure upon the pericardial portion of that nerve.

## RELATIONSHIP TO POST-OPERATIVE CHEST COMPLICATIONS

Whether high hemidiaphragm is the result of paralysis or not, and regardless of the cause of the problematical paralysis, the fact that a certain percentage of cases presents a high clear-cut arch of one dome only, without demonstrable collateral lung disease, has a certain significance in the interpretation of bedside post-operative X-ray examinations of the chest.

Knowledge that this condition exists warns one against interpreting a high dome plus hypoventilation as sufficient evidence upon which to base an opinion of massive atelectasis. It is probable that many of us who make post-operative X-ray studies of the chest have more than once rendered an opinion of atelectasis in the presence of this combination of X-ray signs, and wondered at the time how atelectasis of sufficient degree to cause these marked signs could exist without exhibiting more density, and why the mediastinum did not do its share of the compensation. Perhaps reports in the literature (2) which refer to restriction of a hemidiaphragm as an early sign of atelectasis are based on this condition. It is probably more nearly correct to look upon it as a contributing causal factor rather than a resultant sign.

A paralytic hemidiaphragm may be the explanation of a demonstration in massive atelectasis cases which has been puzzling some of us for a long time. Thus, one of two cases of massive atelectasis of apparently equal areas of lung involvement will show high ascent of the collateral diaphragm and a small amount of mediastinal shifting, while the other case will show short diaphragmatic ascent and a wide mediastinal shift toward the affected lung. Is it not possible that inhibition of the diaphragm in one case and good tonicity in the other might account for this phenomenon? The repeated occurrence of this variation in the replacement action of the diaphragm and mediastinum in previously healthy chests in which there are no adhesions of mediastinum or pleura, strengthens the evidence that inhibition is a cause of the unilateral high position of the diaphragm as a condition preceding atelectasis. High, poorly functioning hemidiaphragm is a likely contributing cause to post-operative atelectasis, for it cannot be denied that a lung deprived of its more important muscle of respiration will have more difficulty in maintaining freely open passage away from the lung field to the outside atmosphere.

## SUMMARY

1. Forty-three per cent of ninety-four surgical cases subjected to pre- and post-operative chest X-ray examinations have shown a unilateral high position of one hemidiaphragm. The immediate cause of

this observation is undetermined, but may be due to paralysis.

2. Fifty-seven per cent exhibited bilateral high position of the domes. The causes are more obvious and apparently do not include paralysis.

3. Both phenomena, but especially the unilateral high diaphragm, deserve attention in the study of the diagnosis and treatment of post-operative chest complications and in interpretation of post-operative X-ray examinations. Cases exhibiting both conditions at once cause the heart to assume a horizontal position suggesting displacement to one side or the other, and this, combined with a high position of one dome of the diaphragm, may give an erroneous impression that atelectasis is present.

## BIBLIOGRAPHY


(1) CUNNINGHAM, DANIEL J.: Textbook of Anatomy. William Wood & Co. Vol. I.

(2) HENDERSON, YANDELL: Physiology of Atelectasis. Jour. Am. Med. Assn., July 13, 1929, XCIII, 96.

(3) BRUBAKER, ALBERT P.: Textbook of Physiology. P. Blakiston's Son & Co. Eighth Edition.

(4) PASTEUR, W.: The Causation of Post-operative Massive Collapse of the Lung. Lancet, May 16, 1914, CLXXXVI, 1428.

(5) MULLER, GEORGE P., OVERHOLT, RICHARD H., and PENDERGRASS, EUGENE P.: Post-operative Pulmonary Hypoventilation. Arch. Surg., December, 1929, XIX, 1322.

(6) PATEY, D. H.: Effect of Abdominal Operations on the Mechanism of Respiration. British Jour. Surg., January, 1930, XVII, 487.

(7) MULLER, GEORGE P.: Perversions of the Function of the Diaphragm. Minnesota Med., December, 1929, XII, 742.

(8) HEAD, JEROME R.: The Effect of Operation upon the Vital Capacity. Boston Med. and Surg. Jour., July 21, 1927, CXCVII, 83.

(9) ALLEN, KENNETH D. A.: X-ray Diagnosis. Colorado Med., November, 1930, XXVII, 424.

(10) HEAD, JEROME R.: Redistribution of Respiration Following Paralysis of the Hemidiaphragm. Surg., Gynec. and Obst., June, 1930, L, 929.

(11) ANDRUS, WILLIAM DEW., and WILSON, J. D.: The Effects of Closed Pneumothorax and Phrenicotomy on the Cardiorespiratory Function. Arch. Surg., December, 1929, XIX, 1205.

(12) SISE, L. F., MASON, R. L., and BOGAN, I. K.: Prophylaxis of Post-operative Pneumonia; Preliminary Report of Some Experiments after Upper Abdominal Operations. Anesthesia and Analgesia, May-June, 1928, VII, 187.

(13) HIGGINS, G. M., BEAVER, M. G., and LEMON, W. S.: Phrenic Neurectomy and Peritoneal Absorption. Am. Jour. Anat., Jan. 15, 1930, XLV, 137.

(14) PRYOR, JOHN H.: Immobility of the Diaphragm Following Pleural Exudates: Preliminary Report. New York Med. Jour. and Rec., April 22, 1916, CIII, 781.

(15) BRUNN, H., and BRILL, S.: Observations on Post-operative Pulmonary Atelectasis: Consideration of Some Factors in Its Etiology, Prevention, and Treatment. Ann. Surg., November, 1930, XCII, 801.

(16) OVERHOLT, RICHARD H.: Post-operative Pulmonary Hypoventilation. Jour. Am. Med Assn., Nov. 15, 1930, XCV, 1484.

(17) RAVDIN, I. S., and KERN, RICHARD A.: Pulmonary Complications Following Anesthesia and Operation: Statistical Study. Arch Surg., July, 1926, XIII, 120.

# RADIOGRAPHY BY THE USE OF GAMMA RAYS[1]

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Contribution from the Division of Physical Metallurgy, Naval Research Laboratory, Washington, D. C.

*Abstract.*—The possible uses of γ-rays for detection of defects in metallurgical materials have been made the subject of a preliminary investigation. The physics of γ-rays from the standpoint of radiography have been explored, and radiographic experiments performed. It has been found that, given a sufficient source of γ-rays, satisfactory radiographs may be taken of steel objects the thickness of which far exceeds that now possible by means of X-rays. Radiographs have been taken with some degree of success through ten inches of steel. These results are discussed, with notes upon possible practical use of the method.

## INTRODUCTION

THE use of X-rays for taking shadow pictures of metallurgical and other materials has, during the last fifteen years, been made the subject of many articles in various scientific journals. It is now admitted that radiography by the use of X-rays is very serviceable in the detection and location of defects characterized by density differences, and accordingly industry is increasingly adopting the method.

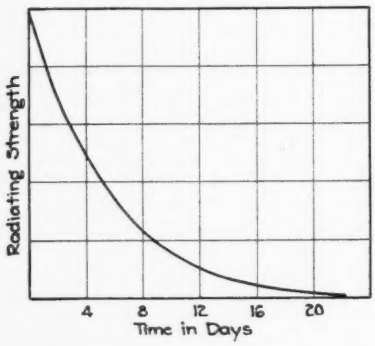


Fig. 1. Decay curve for radium emanation.

There is, however, another type of radiation which holds potential value for radiography, namely, the γ-rays emitted by radioactive substances. They are rays much more penetrative than ordinary X-rays, and would appear to possess certain other advantages for radiographic use. Since X-rays seem limited for practical use to sections 3½ to 4 inches at most in thickness, and since industry, owing to the development of larger structures and of high temperature and high pressure processes, frequently desires information on parts thicker than this, any radiographic method capable of inspecting thicker sections should be of interest.

The literature is surprisingly deficient in information upon the radiography of opaque objects by γ-rays, except for statements that radiographs of the human body obtained by the use of γ-rays do not show details as clearly as do those made by X-rays, that is, that the contrast is not so great. As we shall see, this is because of the lower absorption or greater penetrability of the γ-ray. Years ago, Rutherford[2] noted that γ-rays from 30 mg. of radium could be detected with an electroscope after passing through 30 cm. of iron. Thin strips of metal have been radiated by γ-rays and the transmitted ray observed upon a fluorescent

[1]Paper presented at the Twelfth Annual Meeting of the American Society for Steel Treating, Chicago, September, 1930. Published by permission of the Navy Department, Washington, D. C., and the American Society for Steel Treating, Cleveland, Ohio.

[2]E. Rutherford: Radio-active Substances and Their Radiations, Cambridge University Press, 1913, p. 257.

screen. But so far as we have been able to discover there has been no attempt to use γ-rays for the inspection of opaque bodies except that reported from Russia.[3] According to the meager information available it characteristics of γ-rays. Since the source of γ-rays used was radium emanation, the most suitable source, these notes will be restricted to γ-rays as obtained from radium emanation.

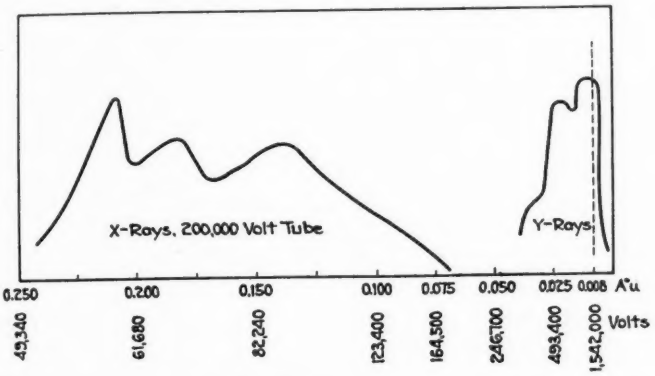


Fig. 2. Curves showing intensities at various wave lengths for X-rays (Terrill and Pine) and for γ-rays (Skobelzyn). The dotted line represents the mean value for γ-rays. (Given by Ellis and Wooster.)

was found possible to locate flaws in steel castings, detecting the emergent beam by an electroscope or a galvanometer and recording the intensity of the beam automatically. No details of this work have ever been made public, so far as the present authors are aware.

It may be said, therefore, that but little has been done on the use of γ-rays for radiography. The present investigation is an attempt, in a preliminary way, to evaluate the use of γ-rays for the detection and location of defects in metallurgical materials.[4]

## THE PHYSICS OF γ-RAYS

In order that the ensuing account may be made clear it is thought advisable to comment briefly upon certain of the physical

Possibly the most noteworthy fact about the radio-active elements is that they transform or decompose to chemically and physically different elements. These transformations are accompanied by radiation, of which there are three types, the α-rays, which are known to be helium atoms with a double positive charge, β-rays, which are electrons, and γ-rays, which are light waves of very short wave length. The first product in the decomposition of radium is radium emanation, or radon. It is a chemically inert gas,

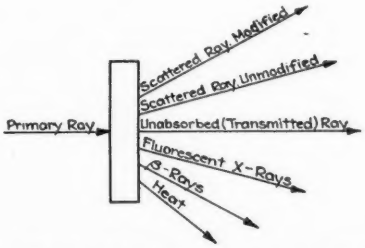


Fig. 3. Changes suffered by radiation in penetrating matter.

[3] As published by Science News Service, No. 361E. Sheet 1, Feb. 24, 1928. It has been impossible to obtain by correspondence information additional to that appearing in the Science News Service report.

[4] The experiments described in the following were performed during the Summer of 1929.

over a hundred times heavier than hydrogen. This gas, radon, in turn decomposes and forms successively Radium A, Radium B, this, it may be seen that a given quantity of radium produces a constant quantity of radium emanation each second, which, in

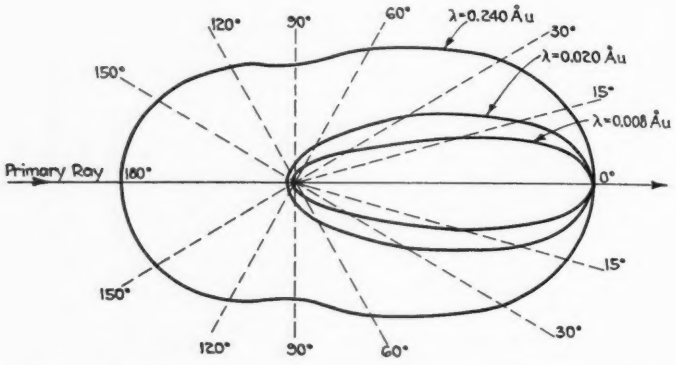


Fig. 4. Distribution of intensity of modified rays scattered at various angles, with primary rays of wave length 0.240 Å.U. (X-rays), 0.020, and 0.008 Å.U. (γ-rays).

Radium C, Radium D, etc., with the final product lead.

Each of these radio-active elements is characterized by a certain rate of decomposition. If the amount present be evaluated (in the usual way) by the strength of the radiation emitted, the rate of decay may be given as

$$\frac{I}{I_0} = e^{-\lambda t}$$

where I is the intensity measured after time t, $I_0$ the original intensity, and λ is the fraction of atoms present which transforms in time t. This is a general law for all radio-active substances. Accordingly, the strength of all radio-active substances decreases logarithmically with time (Fig. 1). Since it is impossible to speak of the life of the emanation (for it is infinite), it is customary to speak of the half-life period, that is, the period in which the radio-active strength decreases to half its original value.

The half-life of radium is about 1600 years. It may, therefore, over a short period be considered as unchanging. Granted turn, decomposes to Radium A, and so on. With a constant rate of production of radium emanation the amount of radium emanation will build up until the rate of decay of the emanation exactly balances the rate of its formation. At this point the radium and its emanation are said to be in equilibrium.

The transformation of radium to radium emanation is accompanied only by an emission of α-rays. So far as γ-rays are concerned, the radio-active properties of radium in equilibrium with its products are, therefore, possessed completely by the radium emanation, and for practical purposes it is better to use the emanation.

In medical practice radium emanation is pumped from the parent radium salt (usually in solution) and condensed from the gases with which it is mixed by liquid air. Each gram of radium in the equilibrium state furnishes 0.6 cubic millimeter of gas. This condensed gas is pumped into small glass capsules ordinarily held in small brass containers. The chief source of γ-rays seems to be Radium C, into which radium emana-

tion decomposes. This series of transformations, with the radiations which accompany them and with the half-life periods, is indicated by the following:[5]

$$\text{Ra} \xrightarrow{\alpha} \underset{\text{1580 yrs.}}{\text{Ra Eman.}} \xrightarrow[\text{3.85 days}]{\alpha} \underset{\text{3.05 min.}}{\text{RaA}} \xrightarrow{\alpha} \underset{\text{26.8 min.}}{\text{RaB}} \xrightarrow{\beta,\gamma} \underset{\text{19.5 min.}}{\text{RaC}} \xrightarrow{\beta,\gamma} \left\{ \begin{array}{l} \text{RaC}' \xrightarrow[10^{-6}\text{ sec.}]{\alpha} \\ \text{RaC}'' \xrightarrow[\text{1.32 min.}]{\beta,\gamma} \end{array} \right\} \underset{\text{1.32 min.}}{\text{RaD}}$$

As freshly pumped off the emanation reaches its maximum radiating intensity within a few hours, the time necessary for the production of the maximum amount of RaC. Thereafter the strength decreases logarithmically, according to Figure 1, the half-life period being 3.9 days.

The strength of the emanation is measured in millicuries, a millicurie being the strength of 1 milligram of radium in equilibrium with its products as measured by an electroscope receiving the $\gamma$-rays only. In medical practice it is customary to pump off the emanation each day. With this procedure, one gram of radium will furnish 160 millicuries of the emanation daily, of which about 150 millicuries is recovered by a skilled operator. Accumulating this emanation day by day one may build up a permanent stock of emanation, with a total

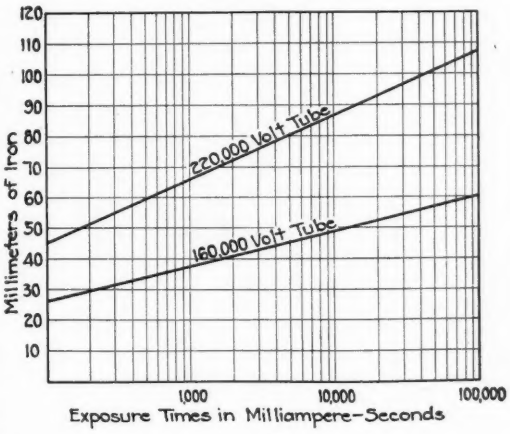


Fig. 5. Exposure curves for X-rays; for a distance of 16 inches from source and with the use of two intensifying screens.

[5]See, for example, A. Sommerfeld: Atomic Structure and Spectral Lines, Methuen & Co., Ltd., London, 1923, p. 47.

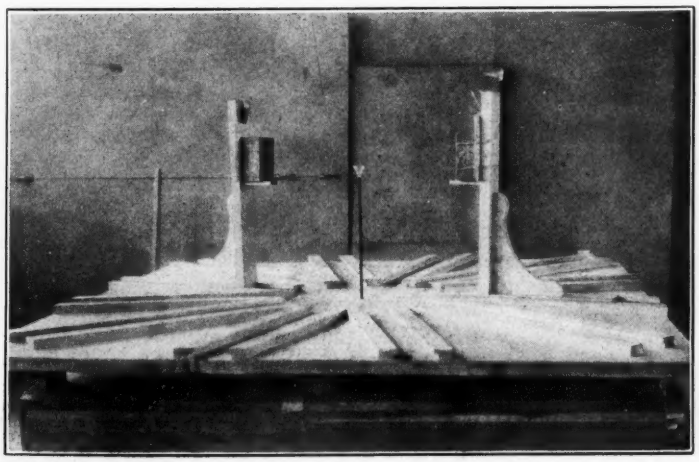

Fig. 6. Table used in $\gamma$-ray radiography. Funnel holding radium emanation shown in center.

strength between 800 and 900 millicuries available for radiographic purposes.

*Wave Length of γ-rays.*—Approximations have been made indicating[6] that the γ-ray spectrum lies somewhere in the range 4.100 to 0.005 Å.U. The distribution of intensity in the γ-ray spectrum has recently been studied by a number of workers.[7]

The relative intensities found by Skobelzyn for the various wave lengths in the γ-ray spectrum are shown in Figure 2.[8]

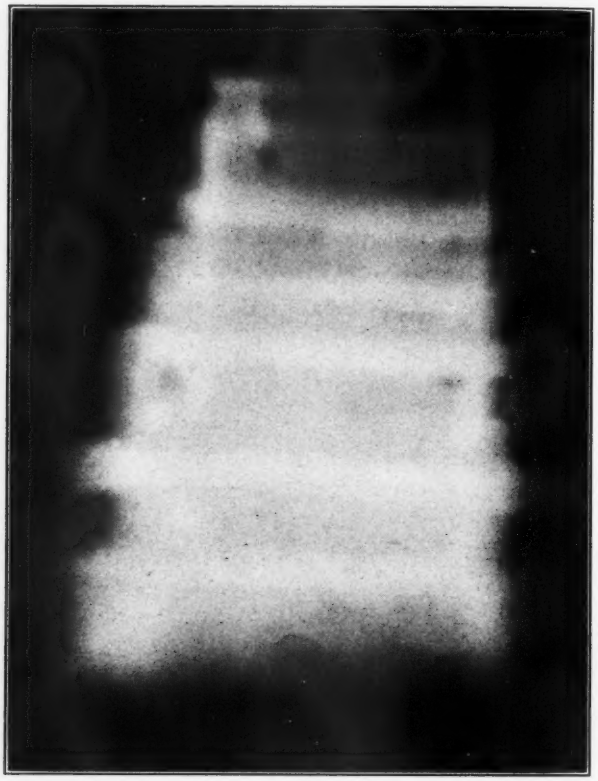

Fig. 7. An echelon of steel plates, as illustrated in Figure 8 (Film No. 1). Distance, source to film, 6 in.; intensifying screen, none; time of exposure, 25 min.; mean strength of emanation, 179 millicuries in one bulb. *Results:* Considerable detail on original negative lost in this illustration. Original exposure just sufficient to bring out all details, though enhancing screens would have decreased the exposure time. The spreading on the film was caused, of course, by the closeness of the object to the source.

[6]Meyer and Schweidler: Radioaktivität, Teubener, Berlin, 1927, p. 148.

[7]D. Skobelzyn, Ztschr. f. Phys., 1927, XLIII, 368; K. W. F. Kohlrausch, Phys. Ztschr., 1927, XXVIII, 2; J. Thibaud, Ann. de Phys., 1925, V, 119; C. Ellis and W. Wooster, Proc. Camb. Phil. Soc., 1925, XXII, 853; idem, 1925–27, XXIII, 717-729.

[8]It seems likely that the γ-ray spectrum, originating from an atomic disintegration, is not a "white" or continuous spectrum, but a spectrum of discrete lines. As the ray emerges from the atom, however, it doubtless suffers a modification in wave length owing to interaction with the radioactive substance itself and with any filter in its path, converting the separate rays through Compton scattering into a continuous spectrum. Skobelzyn determined the relative intensities of the different wave lengths by the number of recoil electrons of given velocity (corresponding to a given wave length of γ-ray) in a Wilson cloud chamber. His curve is "ironed out" in Figure 2 to give a smoother curve than he observed, and Figure 2, therefore, makes the intensity distribution appear more equable than it probably is. There is still some question as to where the limits of the γ-ray spectrum lie. There is evidence of rays at wave lengths greater than 0.040 A.U., and some suggestion of rays around 0.002 A.U. The limits of the γ-ray spectrum are, therefore, not defined in Figure 2. In addition, Skobelzyn's determina-

The measurements made by Ellis and Wooster suggest a mean wave length for the γ-ray spectrum of 0.008 Å.U., corresponding to a voltage of 1,500,000 volts as indicated in Figure 2, somewhat shorter than the approximate mean wave length to be derived from Skobelzyn's curve. On Figure 2 is also represented the relative intensities found by Terrill and Pine[9] for the various wave lengths in the X-ray spectrum as obtained from a 200,000-volt X-ray tube with a tungsten target after filtering through 1 mm. of copper. It is to be noted that the γ-ray curve in Figure 2 applies to γ-rays after filtering through 3 mm. of lead, whereas the X-ray curve was taken with 1 mm. copper filter. This difference in filters

tion of distribution of intensities rests upon only 160 observed recoil electron paths, a number insufficient to define the intensity distribution curve with high accuracy. The curve given in Figure 2 may, however, be taken as approximately correct. The data from which Figure 2 was plotted refer to γ-rays filtered through 3 mm. of lead.

[9] H. M. Terrill and Mary Pine: Jour. Cancer Research, 1924, VIII, 71.

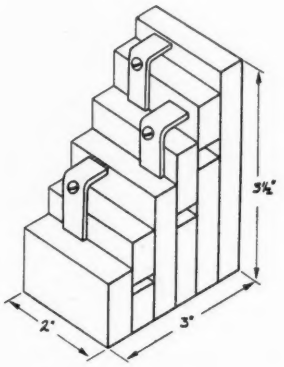


Fig. 8. Diagram of built-up specimen radiographed in Figure 7.

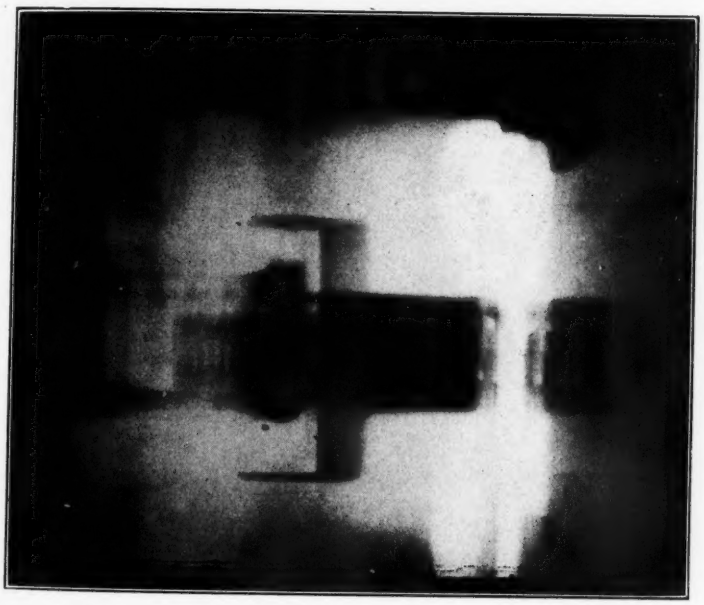

Fig. 9. A tool rest from a lathe. Overall length of section photographed 8½ in.; height, 6½ in. (Film No. 2). Distance, source to film, 26 in.; intensifying screen, none; time of exposure, 12 hrs.; mean strength of emanation, 181 millicuries in one bulb. *Results:* Film badly over-exposed. With intensifying screens only a small fraction of the exposure time noted would have been necessary. A high degree of detail was brought out on the original film.

exerts some distorting effect upon the true distribution curves, but for the present purpose the curves given in Figure 2 may be taken as a nearly true index of the distribution of wave lengths in the two spectra.

The areas under the intensity curves in Figure 2 are entirely dependent upon the intensity of the source, whether it be an X-ray bulb or a tube of radium emanation. In Figure 2 the two curves are drawn simply to give approximately equal heights. It is, of course, the much shorter wave length of the γ-ray as indicated in Figure 2 which accounts for the much lower absorption of the γ-rays in radiography.

Fig. 10. Wrench, 8½ in. long (Film No. 3). Distance, source to film, 66½ in.; intensifying screen, none; time of exposure, 10½ hrs.; mean strength of emanation, 2,181 millicuries in six bulbs. *Results:* All details shown very clearly. Film somewhat over-exposed. Distance from source very great. With a shorter distance and by the use of intensifying screens, a shorter time and a weaker source would have sufficed. Note increase in sharpness of all details in Films No. 1 to No. 3, with increase in distance from source to film, as to be expected. The lack of halo around the edge of the specimen indicates that the usual precautions taken in X-ray radiography to prevent halo are unnecessary when radiographing thin specimens by γ-rays.

Fig. 11. Faulty weld, 2½-in. steel plates, lap-welded (Film No. 4). Distance, source to film, 30 in.; intensifying screen, none; time of exposure, 12 hrs.; mean strength of emanation, 217 millicuries in one bulb. *Results:* Lack of bond clearly shown (indicated by arrows). This reproduction is not nearly so good as the original film. Exposure excessive. Time of exposure could have been much less, especially by use of Patterson screens.

*Absorption and Scattering.*—The γ-ray

beam issuing from a bulb of radium emanation has approximately the distribution of wave lengths indicated in Figure 2 (after, as noted, passing through 3 mm. of lead, which absorbs the softer rays preferentially). As this ray passes through a metal object it suffers a number of changes. The emergent ray is complex, as indicated in Figure 3.

The emergent $\gamma$-ray beam is weaker than the direct beam because of loss of intensity through simple absorption (converted into heat) and through scattering. This emergent intensity may be represented by an equation

$$I = I_0 e^{-\mu x}$$

where $I_0$ is the initial intensity (assumed to be a simple wave length), x the thickness of the absorbing medium, and $\mu$ the total absorption coefficient.

The total absorption coefficient $\mu$ is actually affected by two agencies, namely,

Fig. 12. Faulty weld, butt-welded (Film No. 5). Distance, source to film, 30 in.; intensifying screen, none; time of exposure, 12 hrs.; mean strength of emanation, 179 millicuries in one bulb. *Results:* Imperfections clearly shown.

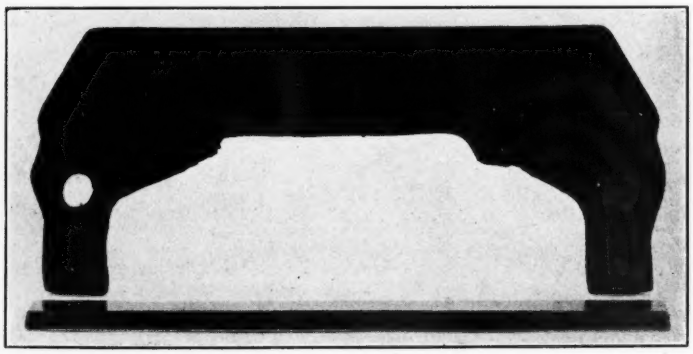

Fig. 13. Photograph of steel casting of which radiographs are shown in Figures 14 and 15.

Fig. 14

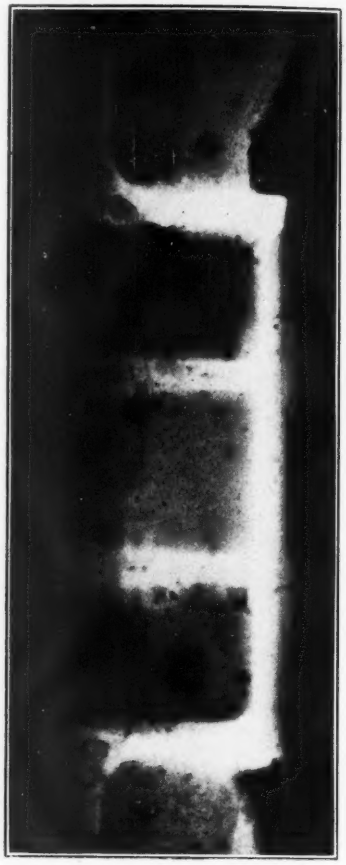

Fig. 15

Fig. 14 *(left)*. Steel casting with sand inclusions, shown in Figure 13. Thickness of web between ribs, ¼ in. of rib at base, 1 in. (Film No. 6). This X-ray radiograph shows clearly the presence of sand inclusions. The method of photographic reproduction has increased the contrast considerably in Films No. 6 and No. 7. The figure "2" has no significance.

Fig. 15 *(right)*. Film No. 7. Distance, source to film, 30 in.; intensifying screen, none; time of exposure, 12 hrs.; mean strength of emanation, 217 millicuries in one bulb. *Results:* Film darker than necessary. Fairly good reproduction of original film except detail in ribs lost. With Patterson screens the exposure time could have been very considerably decreased.

A comparison between Figures 14 and 15 is important in comparing the γ-ray and the X-ray methods for radiography. Every detail which could be discovered upon the X-ray photograph (Fig. 14) could also be found upon the γ-ray photograph (Fig. 15). The contrast upon the film between a defect and the background is greater upon the X-ray film. Because of the lower absorption coefficient for γ-rays, however, the whole of the casting is satisfactorily exposed upon the γ-ray photograph, whereas the ribs are badly under-exposed upon the X-ray film. It is possible that a better X-ray photograph could be obtained, but it is inescapable that it should be easier to radiograph an irregular section with γ-rays than it is with X-rays. Precautions were taken to eliminate scattering at the edges of the specimen in the X-ray radiograph of this piece (Film No. 6), but not in this γ-ray radiograph. The complete lack of halo at the edges of the casting indicates that such precautions are unnecessary when γ-rays are used on rather thin specimens.

true absorption and scattering. Neither X-rays nor γ-rays from a bulb of radium emanation are homogeneous in wave length (Fig. 2). Accordingly the first absorbing layers remove a large fraction of the less penetrating rays, so that only the more penetrating or "hard" rays reach the final layers. For such non-homogeneous beams the effective value of μ is much greater for the rays which enter the absorbing object than for those which leave it. According to Kohlrausch,[10] the total absorption coefficient for γ-rays may be represented by two absorption coefficients, $\mu_1$, and $\mu_2$, where

$$I = I_0 \left( e^{-\mu_1 x} + 0.75\, e^{-\mu_2 x} \right),$$

for iron $\mu_1 = 0.356$ and $\mu_2 = 0.632$ cm.$^{-1}$, with an average value in the neighborhood of 0.5 cm.$^{-1}$.

Taking 0.15 Å.U. as the effective wave length of X-rays from a 200,000-volt tube (Fig. 2), the corresponding coefficient for iron is 4.5 cm.$^{-1}$. These coefficients thus indicate the greater penetrability of the γ-rays.

[10]Meyer and Schweidler: Radioaktivität, Teubener, Berlin, 1927, p. 644.

It has been stated that the total absorption coefficient represents the sum of a true absorption coefficient and a scattering coefficient. The scattered ray is of considerable importance to radiography, since it commonly fogs the registering film. To combat the scattering, various screening devices have been introduced, such as simple lead shields and the more complicated Potter-Bucky diaphragm.[11]

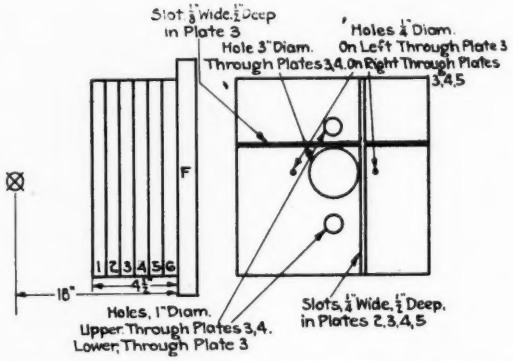
Slot ¼" Wide, ½" Deep in Plate 3
Hole 3" Diam. Through Plates 3,4
Holes ¼" Diam. On Left Through Plate 3 On Right Through Plates 3,4,5
F
1 2 3 4 5 6
18"
4½"
Holes, 1" Diam. Upper Through Plates 3,4. Lower, Through Plate 3
Slots, ¼" Wide, ½" Deep, in Plates 2,3,4,5

Fig. 16. Diagram showing method of preparing specimen radiographed in Figure 17.

The scattering of γ-rays differs from that of X-rays owing to the shorter wave length. The difference is in three categories: (*a*) the fraction of the beam scattered (the magnitude of the scattering coefficient), (*b*) the angular distribution of the scattered ray, and (*c*) the modification of the wave length upon scattering[12] (Compton effect).

(*a*) It is difficult to make any definite statement concerning the ratios of the true absorption and scattering coefficients for X-rays and γ-rays, except that both these coefficients are smaller for γ-rays than

[11]See, among many publications, that of the Eastman Kodak Company, entitled "X-rays in Industry," 1929.

[12]Fluorescent radiation in both the X-ray and γ-ray technic is absorbed before reaching the film and need not be considered here. The ejected photo-electrons suffer a similar fate.

X-rays. There is a lack of data from experiments duplicating radiographic conditions.

(*b*) The angular distribution of intensity is of peculiar interest in radiography. Both the modified and the unmodified ray are distributed more in the direction of the primary beam in the case of the shorter wave lengths than in the case of the longer. Under radiographic conditions the modified rays predominate over the unmodified at practically all scattering angles, so that a curve of angular distribution for the former gives approximately the distribution of the total scattering. Figure 4 gives a series of such curves,[13] and indicates that the distribution of the scattered ray should be less detrimental to the production of good γ-ray radiographs than to good X-ray radiographs.

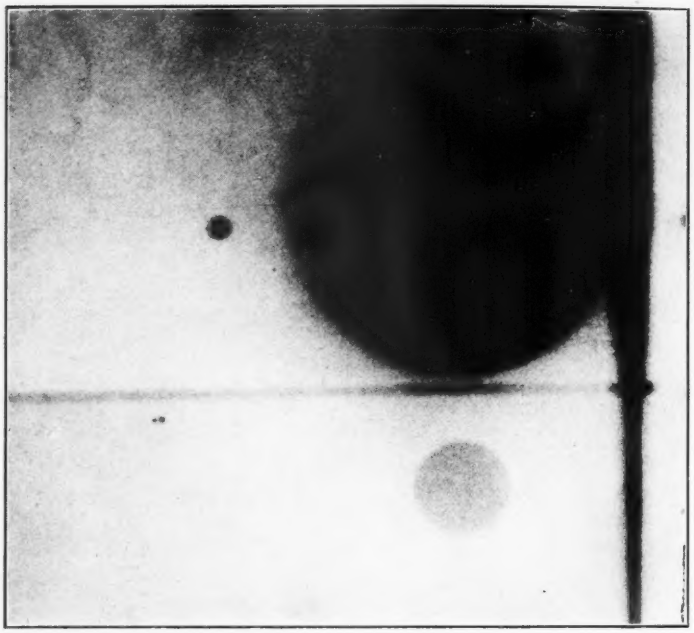

Fig. 17. A series of steel plates, in certain of which were cut holes of several diameters, and slots. Details of arrangement are given in Figure 16 (Film No. 8). Distance, source to film, 18 in.; intensifying screen, film between two Patterson screens; time of exposure, 12 hrs.; mean strength of emanation, 198 millicuries in one bulb. *Results:* Film much darker than necessary. Half the stated exposure time would easily have been sufficient. Contrast on this illustration somewhat greater than on original film. Fogging shown in upper right-hand corner is only very light on the original film. Film covered only part of detailed plate in Figure 16, as may be seen by a comparison of Figures 16 and 17. Smallest hole in left is of particular interest. It appears very strongly here, though it is only ¼ in. in diameter and ¾ in. deep, showing that the γ-ray method in this case brought out strongly a defect ¼ in. in diameter and 17 per cent of the total thickness deep. A similar sensitivity is shown by the lower 1-inch hole. The sensitivity of the method is shown also by the following film.

(*c*) The scattered γ-ray beam suffers a profound modification through the operation of the Compton effect, and in this

[13] K. W. F. Kohlrausch: Handbuch der Experimentalphysik, Vol. XV, p. 132.

respect differs greatly from X-rays. The Compton scattering is an increase in the wave length of the primary beam, the amount of increase dependent upon the angle the scattered beam forms with the primary beam but independent of the original wave length. A beam scattered at an angle 90 degrees to the primary beam suffers an increase in wave length of 0.024 Ångström unit. Such an increase will make only relatively little difference in the scattered X-ray wave lengths (since the effective wave length of the primary beam from a 200,000-volt tube is about 0.15 Å.U.), but will make a great difference in the scattered $\gamma$-ray wave lengths (which are principally between 0.030 and 0.004 Å.U.), dependent upon the angle of scattering.

The scattered $\gamma$-ray beam will, therefore, have a much greater wave length at large angles and a proportionately much greater absorption coefficient. This will, in effect, so far as radiography is concerned, narrow the angular distribution of the scattered $\gamma$-ray beam, since the beam scattered at the greater angles will be more rapidly absorbed by the specimen.

These various considerations indicate that scattering from $\gamma$-rays should not be a greatly harmful influence in $\gamma$-ray radiography, and the degree of success attained in the experiments soon to be described bears testimony to the correctness of this viewpoint.

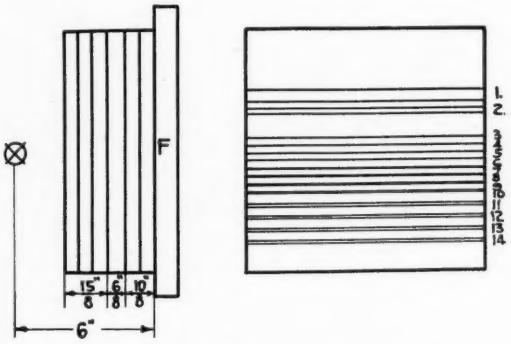


Fig. 18. Diagram showing method of preparing specimen radiographed in Figure 19. Dimensions of slots were as follows:

| No. | Width in mm. | Depth in mm. |
|---|---|---|
| 1 | 13 | 13 |
| 2 | 6 | 13 |
| 3 | 1 | 2 |
| 4 | 1 | 3 |
| 5 | 1 | 6 |
| 6 | 1 | 12 |
| 7 | 2 | 2 |
| 8 | 2 | 3.5 |
| 9 | 2 | 6.5 |
| 10 | 2 | 12 |

*Photographic Exposure Characteristics.*—A great deal has been written about photographic exposure characteristics for radiography by the use of X-rays. The information desired is simply the shortest exposure time for a given thickness of metal necessary to reveal upon the developed photographic film the density differences—defects—occurring in the object inspected.

There is a fairly wide latitude in the choice of exposure times for different thicknesses, dependent upon the observer's taste

in film density and upon what deviations from the simplest technic are used, such as enhancing screens, special developing methods, and special film-inspecting methods.

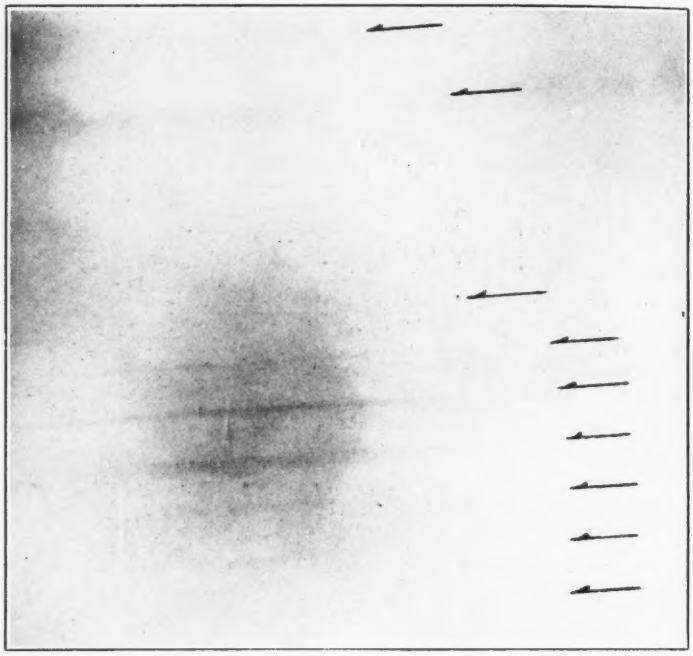

Fig. 19. A series of steel plates, total thickness 3⅞ in., in one of which (marked "6/8" in Figure 18) a number of slots of varying depth and width were cut. Details are given in Figure 18. The slotted side of the plate was turned towards the film (Film No. 9). Distance, source to film, 6 in.; intensifying screen, none; time of exposure, 4 hrs.; mean strength of emanation, 179 millicuries in one bulb. *Results:* This radiograph was taken to test the sensitivity of the γ-ray method for small defects. It must, of course, be borne in mind that the slots illustrated in Figure 18 are well defined geometrically, which is favorable to the test. The original film was nearly of correct exposure, though the use of Patterson screens would have decreased the exposure time. Owing to the close proximity of the source, there is a greater density in the center of the film than at the edges. The great divergence of the rays at the edges likewise had the effect of spreading out the registration of the slots, and this effect, coupled with the diminution of intensity of the ray, made certain of the slots far from the center not visible on the film. Especial attention should, however, be given the five slots registered near the center. The third arrow from the top indicates the photographic result from Slot No. 3 in Figure 18, which was 1 mm. wide by 2 mm. deep. Under the conditions of this experiment, therefore, a defect 1 mm. wide and only 2 per cent of the total thickness deep was detected. The second arrow from the top indicates the photographic result of Slot No. 2. Slot No. 1 is only faintly indicated (top arrow) for the reasons stated above.

To eliminate the fancies of the observer, exposure curves may be given to represent the proper exposures for a given degree of absolute blackening of the film. The absolute blackening is determined by photometric measurements in which the intensity of the light is measured thermoelectrically. The degree of blackening, or density, is then given by the expression

$$D = \log_e \frac{I_0}{I} = 2.3 \log_{10} \frac{I_0}{I}$$

where D = density, $I_0$ = intensity of primary beam, and I = intensity of transmitted beam.

A density of D = 1.15 is sometimes taken as a satisfactory degree of blackening

$$x = \frac{1}{\mu} \log_e kt$$

where x is the thickness, t is the time of exposure required for a given blackening

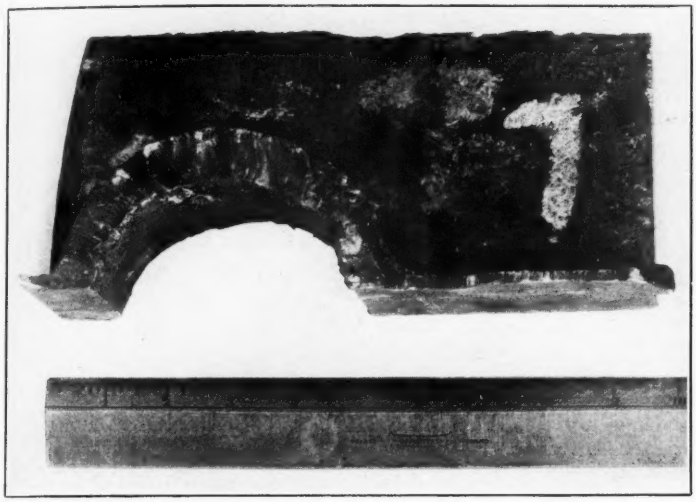

Fig. 20. Steel casting 1 in. thick, with cracks. See Figures 21 and 22 for radiographs.

for radiographic purposes.[14] This density refers to the increase in density above that of the unexposed but developed film.

Figure 5 gives such exposure curves for X-ray tubes operating with a tungsten target[15] at the indicated voltages (D. C.). There is at present no exposure curve available for γ-rays.[16] Neglecting scattering and non-homogeneity of wave length, an exposure curve should have a slope inversely proportional to the linear absorption coefficient of the ray used (when plotted in the usual way, thickness against the logarithm of milliampere-seconds). Mathematically

(for a constant tube milliamperage in the case of X-rays or for a constant millicurie strength in the case of γ-rays), μ is the linear absorption coefficient as before, and k is a constant depending upon experimental conditions. A change in μ is, therefore, much more effective in changing x than a change in t, since the logarithm of t changes very slowly with t. In other words, to increase the thickness range in radiography, a decrease in wave length is much more effective than an increase in time. To illustrate: Consider the difference in exposure time for 3 inches and 6 inches of iron. From Figure 5 the exposure time for 3 inches with a 220,000-volt X-ray tube is 3,000 milliampere-seconds (50 milliampere-minutes), requiring an exposure time of about 10 minutes at a milliamperage of 5. Extrapolating the exposure curve for a 220,000-volt tube

[14] In Briggsian logarithms a density of 0.5.

[15] Adapted from "Der gegenwärtige Stand der Röntgen durchstrahlung von Metallen," Siemens-Reiniger-Veifa, Berlin, 1928.

[16] Some attempts were made to procure such curves by a technic which later proved inadmissible. It is hoped shortly to obtain exposure curves to be used in practical γ-ray radiography. The radiographs reproduced in this paper are not of uniform density, nor are they all of the lowest practicable density, so that the exposure times cannot be taken as a guide except in a rough way.

to 6 inches, the exposure time becomes approximately 15,000,000 milliampere-seconds, at a milliamperage of 5, requiring an exposure time of 50,000 minutes. The ratio of these times is

from a 220,000-volt tube as given above is roughly one hundred times as great.

Thus, though the requisite exposure time for a 6-inch section with X-rays becomes unconscionable, satisfactory radiographs of

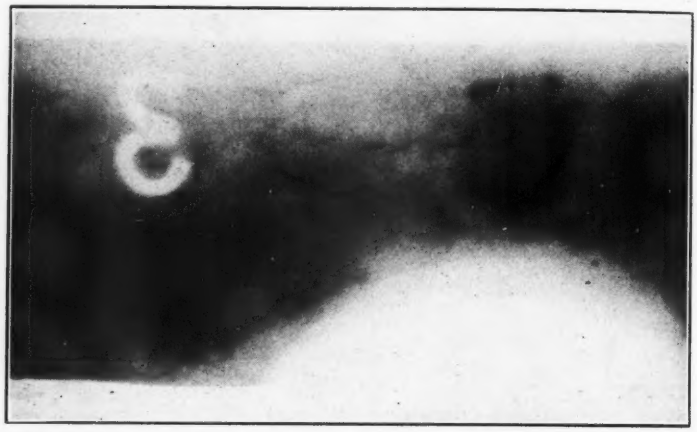

Fig. 21. Steel casting, 1 in. thick, with cracks, as shown in Figure 20. This is an X-ray radiograph. It is not a very satisfactory reproduction of the original film (authors' note). Contrast printing has given a non-uniform appearance, and increased the contrast in the cracks. The edges of the piece are less distinct than on the original film. The figure "3" has no significance (Film No. 10).

$$\left(\frac{t_{6\text{ inches}}}{t_{3\text{ inches}}}\right)_{\text{X-rays}} = 5{,}000$$

For $\gamma$-rays, assuming $\mu = 0.5$, an approximate value for the above ratio may be obtained. The equation

$$x = \frac{1}{\mu} \log_e kt$$

may, for two different thicknesses, be written:

$$x_1 - x_2 = \frac{1}{\mu} \log_e \frac{kt_1}{kt_2} = \frac{1}{\mu} \log_e \frac{t_1}{t_2}$$

substituting 6 inches for $x_1$ and 3 inches for $x_2$, the time ratio becomes

$$\left(\frac{t_{6\text{ inches}}}{t_{3\text{ inches}}}\right)_{\gamma\text{-rays}} = 45$$

where the similar time ratio for X-rays

even thicker sections may be taken with $\gamma$-ray sources now available within reasonable time, as we shall see in the experimental part of the present paper.

The lower absorption of the $\gamma$-ray may be shown by another example. Taking 0.5 as the linear absorption coefficient of $\gamma$-rays, the intensity of the primary $\gamma$-ray beam will be decreased to about $\frac{1}{3}$ by one inch of iron, whereas X-rays, with a linear absorption coefficient of 4.5 (a wave length of 0.15 Å.U.), would be reduced to about 1/100,000 of the original intensity by an equal thickness of iron.

In passing, it probably should be remarked that the inverse square relation between intensity and distance applies to $\gamma$-rays as well as to X-rays. In neither case is there an appreciable absorption in air.

EXPERIMENTAL

*Methods of Recording the Emergent γ-ray Beam.*—There are three possible methods of performing this task: (*a*) by means of the ionizing effects of the ray, (*b*) visually, upon a fluorescent screen, (*c*) by means of a photographic film or plate.

All three of these methods have been tried. The success reported from Russia seemed to warrant an experimental trial of (*a*).

(*a*) Owing to the simplicity and efficacy of the photographic method, no very thorough study of the ionization method was made, though it is believed that the experiments performed warrant the conclusions drawn.

A cylindrical ionization chamber was constructed, 3 inches in diameter and 12 inches long, lined with lead and provided with twelve partitions of lead-coated brass sheet, six of which were connected to a central rod and six to the outer casting.[17] The central rod was insulated with quartz and connected to a vacuum tube amplifier. The outer case was charged to 300 volts. In order to increase the ionization current the chamber was filled with methyl bromide at atmospheric pressure.

The vacuum tube amplifier used was designed after that described by Eglin[18] and was capable of measuring currents of the order of $10^{-13}$ to $10^{-14}$. The most satisfactory tubes tried were the English Marconi

Fig. 22. Radiograph of casting (Film No. 11) shown in Figure 20. Distance, source to film, 66½ in.; intensifying screen, none; time of exposure, 10½ hrs.; mean strength of emanation, 2,181 millicuries in six bulbs. *Results:* Film exposed more than necessary. Exposure at a shorter distance and by the use of Patterson screens would have made a shorter exposure time and a weaker source of radiation sufficient. Films No. 11 and 10 are, of course, to be compared. (It will be noted that Film No. 10 should be reversed, so that "3" reads correctly, in order to match it with Film No. 11.) It may be seen immediately that the cracks showing on Figure 10 are much darker than those on Figure 11. This is the familiar diminished contrast mentioned previously. It will also be noted that certain cracks (above the arch) visible on Film No. 10 cannot be found on Film No. 11. It is uncertain whether the apparently lower sensitivity towards cracks is inherent in the γ-ray method (owing to the lower absorption coefficient) or whether it resulted in this case from the inferior alignment of the direction of the crack with respect to the beam in the case of the γ-ray radiograph.

[17] Similar in construction to that used by A. H. Compton, Phil. Mag., 1921, XLI, 749.

[18] J. M. Eglin: Phys. Rev., 1929, XXXIII, 113A.

type D. E. Q.[19] Readings were taken with a Leeds and Northrup galvanometer.[20]

A lead block with a longitudinal hole was placed between the γ-ray source and the ionization chamber, and served to define a beam half an inch in diameter. Steel blocks of different thicknesses were placed between the lead block and the source. With a 218-millicurie source 10 inches from the front of the ionization chamber it was just possible to detect (in the ionization current) the difference between 7 and 8 inches of steel. In other words, a hole 1 inch deep and ½ inch in diameter could have been detected in 8 inches of steel. Continuing, it was found that a difference could just be detected between 5 and 5½ inches of steel.

In any ionization method the width of the chamber slit is a limiting factor. To detect small imperfections a very narrow slit would be necessary, requiring very high sensitivity in the ionization apparatus. In addition, extremely good insulation would be required, a troublesome matter.

Since these experiments were made technic in the measurement of small currents has been developing rapidly. It is now possible to measure currents smaller than these with rugged and portable equipment. Any comparison of these results with the photographic results so far as sensitivity is concerned would accordingly be premature.

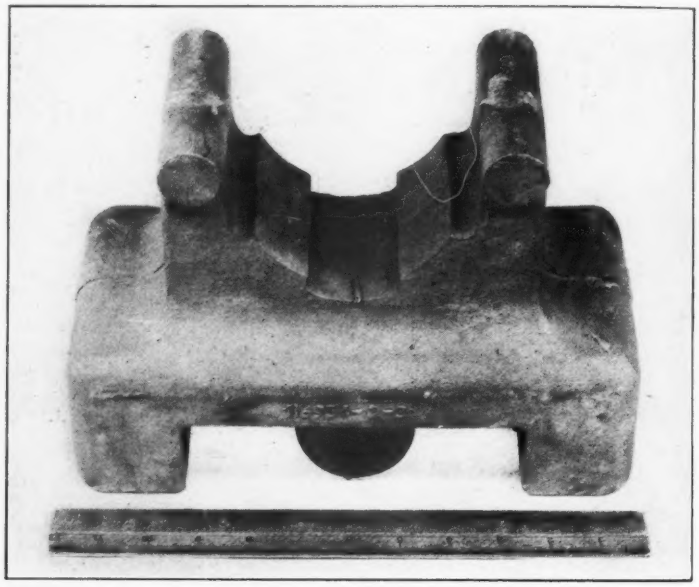

Fig. 23. Bronze casting radiographed in Figure 24.

In order to obtain a record of the opacity of an object by any ionization method it would be necessary, however, to scan the area studied and to chart the variations in ionization current obtained. Such a method would be troublesome, though possibly some automatic scanning device might be worked out.

(*b*) As noted in the beginning of the paper, thin sections of metal had been radi-

[19] Amplification factor 20; impedance 100,000 ohms.

[20] Sensitivity 0.7 mm. per microvolt; 46 ohms resistance; 100 to 500 ohms shunt.

ated by means of γ-rays and the emergent beam observed upon a fluorescent screen years ago by Rutherford. Repetition of this experiment showed the effect to be striking. A moment's consideration, however, is sufficient to discover the inadequacy in such a method, for only very thin sections may be successfully inspected and in such cases no radiographic method is needed unless it be the X-ray.

(*c*) Although at the beginning of this work it was thought that an ionization method of recording the emergent beam was to be preferred because of the speed with which a record might be obtained, it was found that the photographic method yielded surprisingly good results and the work continued by this method entirely. Agfa and Eastman double-emulsion X-ray films were used exclusively.

RADIOGRAPHY BY MEANS OF γ-RAYS

In all, several hundred photographs were taken of divers objects. The authors had at their command the radiographic technic so completely developed for X-rays, but little use was made of many of its details, for, in a pioneer attempt, such as this, it is more economical of time to discover a few essential facts before much endeavor is made towards refinement. Of these many photographs only a selected few are reproduced here, chosen to demonstrate the general nature of the results obtained. The chronology of the experiments performed was not that indicated by the sequence of photographs in this paper, so that there is lacking the indication of improved quality, resulting from experience, observed during the course of the work.

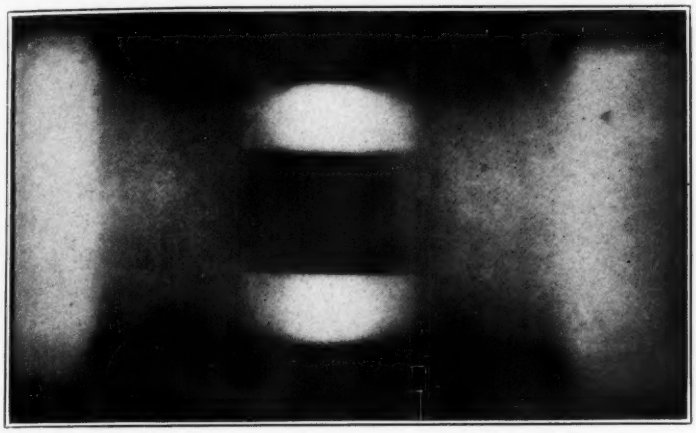

Fig. 24. An irregular bronze casting, a photograph of which is shown in Figure 23 (Film No. 12). Distance, source to film, 26 in.; intensifying screen, none; time of exposure, 10¾ hrs.; mean strength of emanation, 2,100 millicuries in six bulbs. *Results:* Film exposed somewhat more than necessary. Exposure time and strength of emanation could have been further reduced by the use of Patterson screens. Absorption of bronze is greater than that of steel, requiring a somewhat stronger source or a somewhat longer exposure time. A picture taken simultaneously, with film between two sheets of lead foil, gave slightly better contrast but approximately the same density. Note the small flaw in the upper right-hand corner of the casting.

Without any initial conception of exposure times it was inevitable that many photographs should show too little or too much exposure. This may be noted even in the photographs reproduced here, with a hancing screen, some using a Patterson calcium-tungstate screen, and some using a lead backing as an enhancing screen.

For these various reasons the exposure times noted for the various photographs

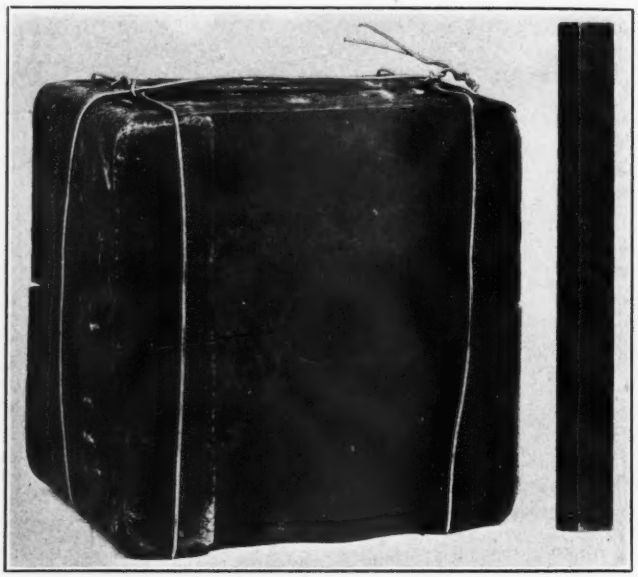

Fig. 25. Block of cast iron with a large hole leading off one face. Assembled after cutting and radiographed in Figure 27.

tendency toward over-exposure. For obvious reasons the shortest possible exposure time is desired. Some films were exposed "plain," that is, without the use of an en-

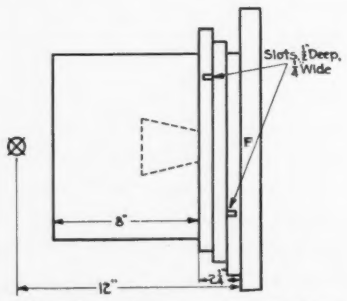


Fig. 26. Diagram of method of preparing specimen shown in Figure 25 and radiographed in Figure 27.

must be regarded carefully.[21] Considering also the fact that most of the films were over-exposed it is obvious that the exposure times noted could have been less.[22]

The specimens radiographed were chosen to represent the important features commonly found in radiography. They include "synthetic" specimens, that is, specimens built up of plates with holes, slots, and so

[21]Estimations of this reduction in exposure time vary. The booklet, "Der gegenwärtige Stand der Röntgendurchstrahlung von Metallen," published in 1928 by Siemens-Reiniger-Veifa, states (page 9) that the exposure time may be shortened to from ⅛ to 1/100, dependent upon the wave length of the ray, the shorter rays giving a proportionately greater saving in time. This would indicate a great saving for γ-rays but as yet no determination has been made.

[22]It is obvious that any development in photography toward shortened exposure times would be of the greatest importance to γ-ray (or X-ray) radiography. Recent experiments in this Laboratory indicate the development of a method which will reduce the exposure time to at least one-half of that now necessary.

on, simulating cracks, voids, and inclusions actually found as defects in metallurgical materials. It was considered best to work first with such synthetic specimens, since the utter lack of previous work made all results uncertain. In addition to such specimens there are included radiographs of a cast iron block with defects, a steel casting with surface cracks, a steel casting with sand inclusions, a bronze casting, and two imperfect welds.

It should be clear, from what has been said, that the necessary equipment and technic is extraordinarily simple. Many of the photographs were taken upon the table illustrated in Figure 6. The thistle tube rising from the center of the table held the radium emanation. Specimens were distributed radially around this, as indicated by the guides on the table top which served to orient the specimens and the photographic film holders. The technic of taking $\gamma$-ray radiographs consisted simply in mounting the metal object to be photographed upon the stand (if the stand were used), aligning it with the thistle tube, adjusting the holder

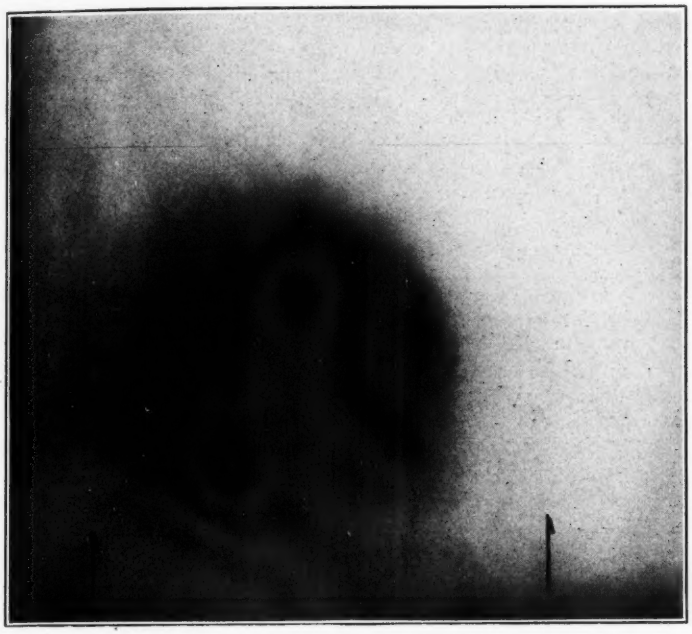

Fig. 27. The block of cast iron shown in Figure 25, with three ¾-in. steel plates, with slots, as shown in Figure 26. Distance, source to film, 12 in.; intensifying screen, none; time of exposure, 10¾ hrs.; mean strength of emanation, 2,100 millicuries in six bulbs. *Results:* Exposure of film nearly correct. Photographic reproduction of Film No. 13 made by photographing film laid upon sheet of white paper. This was found to be a very satisfactory way of viewing negatives that are not too dense. The large hole is very clearly visible; also, the slots in the plates may be seen to right and left of the large hole, indicated by arrows. Exposure time and strength of emanation could have been reduced considerably by the use of Patterson screens. A 1-in. hole in the top and another in the bottom were drilled after taking the radiographs, to facilitate cutting up the specimen, so that naturally they do not appear in any of the radiographs.

containing the film at the rear of the object, lowering the metal capsule containing the bulb of radium emanation in the thistle tube, and receiving the film holder at the

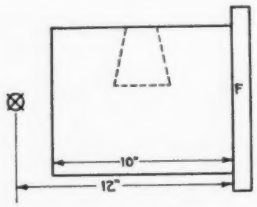


Fig. 28. Diagram of method of preparing the specimen radiographed in Figure 29.

is, spherically. In appraising the cost of such a method of inspection this feature must be remembered.

### γ-RAY RADIOGRAPHS

The descriptive matter accompanying the radiographs needs a word in explanation.

The technic described in the third paragraph above was always used, except that certain objects were photographed upon the floor. Diagrams of the relative positions of the emanation, object, and film holder are given only when necessary.

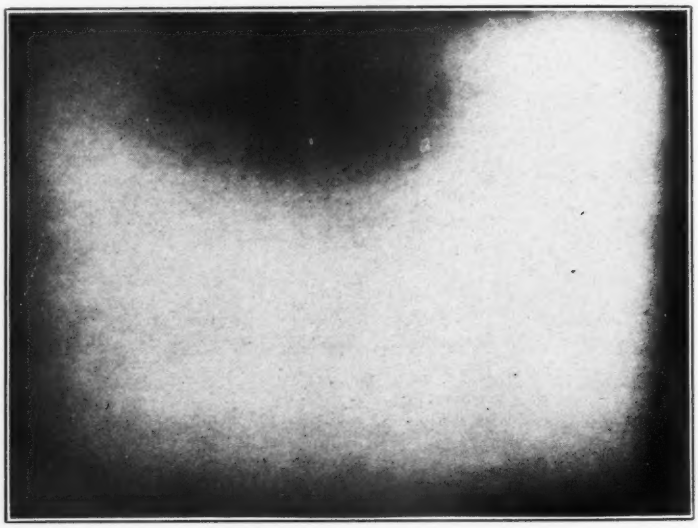

Fig. 29. Same as with Film No. 13 (Fig. 27), except without steel plates. Hole on the side of casting, as shown in Figure 28. Distance, source to film, 12 in.; intensifying screen, one Patterson screen; time of exposure, 8 hrs.; mean strength of emanation, 1,150 millicuries in two bulbs. *Results:* Original film imperfect, giving a "spotty" radiograph. The hole in the side is clearly visible, but distorted owing to divergence of the beam. Film is badly over-exposed.

expiration of the exposure time. The films used and the developing procedure were similar to those in X-ray radiography.

It is an important feature of this method that many specimens may be arranged around the γ-ray source, for the radium emanation emits γ-rays in all directions, that

"Distance, source to film," refers to the distance, in inches, from the bulb of radium emanation to the film holder. The information listed after "intensifying screens" is self-explanatory, as is that after "time of exposure." "Mean strength of emanation" refers to the radiating strength of the

emanation half-way through the exposure. The strength of the emanation was, therefore, somewhat greater at the beginning of

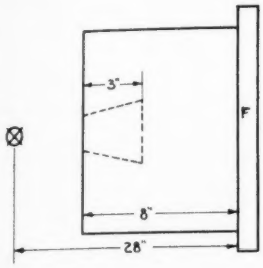


Fig. 30. Diagram showing method of preparing specimen radiographed in Figure 31.

the exposure and somewhat less at the end than that of the value given (see Fig. 1). Under "Results" are listed a few essential features in the radiograph to which it is desired to call attention. Several of the γ-ray radiographs are accompanied by X-ray radiographs of the same object for purposes of comparison.

The radium emanation was held in a small (⅛ inch in diameter) glass capsule, enclosed in a brass sheath, ½ inch in length, 3/16 inch in diameter. In several cases, when strong sources were used, more than one of these containers were used, as will be noted. The use of several containers is not to be recommended in general, since it increases the dimensions of the radiating source and, therefore, operates against a high degree of definition in the resulting radiograph.

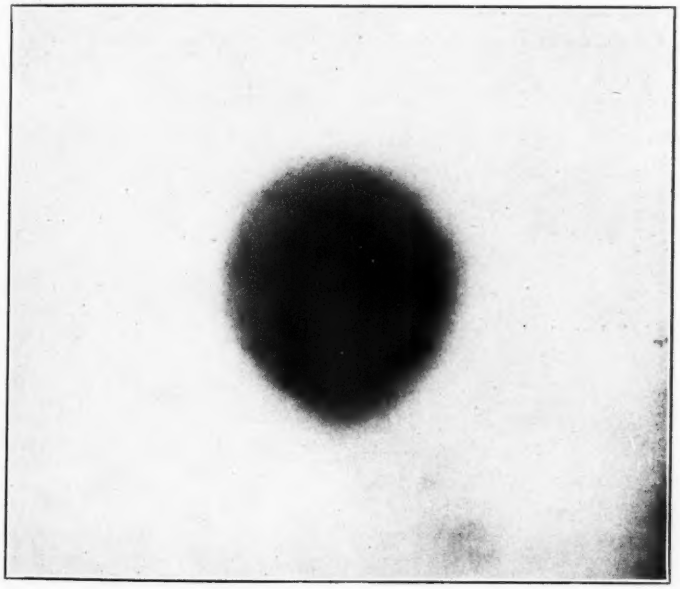

Fig. 31. Same as with Film No. 14 (Fig. 29). Hole towards source, as shown in Figure 30 (Film No. 15). Distance, source to film, 28 in.; intensifying screen, one sheet of lead foil; time of exposure, 10½ hrs.; mean strength of emanation, 2,181 millicuries in six bulbs. *Results:* Exposure greater than necessary. The larger hole may be clearly seen. In addition to this, there may be discovered in the original of Film No. 15 a cloud-like image floating over the large hole and downwards slightly to the right. This suggested a defect in the back of the block, which, upon cutting, was found—see Figure 32.

The usual difficulty in photographic reproduction of the original radiographs for publication was experienced, perhaps somewhat more severely, for the γ-ray radiographs do not show as great a contrast as the ordinary X-ray radiographs. The films were mounted on wooden frames, inserted in a light-tight viewing cabinet, and photographed with a brilliant source of illumination at the rear. Best results were obtained with process plates (Wratten M) and with printing upon contrast paper (Azo glossy, usually No. 4). It is inevitable that the published reproductions of the original radiographs should be unsatisfactory. In each case under "Results" are given a few sentences comparing the reproduction with the original film.

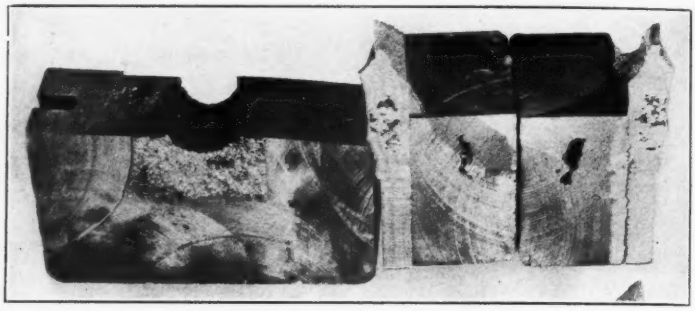

Fig. 32. Defects in block shown in Figure 31.

The first three films, respectively of an echelon of steel plates, a lathe tool rest, and a wrench, were taken merely to test the sensitivity of the γ-ray radiographic method for detail. These are all within the X-ray range of thickness.

## DISCUSSION AND SUMMARY

The aim of the present work may be stated in simple terms: it is an attempt to appraise in a preliminary and in a purely scientific fashion the use of γ-rays for the radiographic detection of defects in metallurgical material. It does not, therefore, present a finished testing method to industry; nor is there any attempt to analyze the economics in any possible commercial exploitation. This latter task must be left to those whose interest might make such a testing method desirable.

The results attained are those illustrated by the γ-ray radiographs and itemized under "Results" in the appended descriptions. To complete the appraisal possible at this time these results should now be recapitulated; and, furthermore, the practical features surrounding the use of a γ-ray method of inspection should be set forth.

The physics of γ-rays (developed from the standpoint of radiography) in the Introduction indicates that γ-rays, because of their shorter wave length (Fig. 2) and correspondingly lower absorption coefficient, should be able to penetrate thicknesses of metal with a smaller loss of intensity than X-rays, and, moreover, for the same reason, should not require for great thicknesses the relatively tremendous increase in exposure time characteristic of the X-ray wave lengths now commonly in use.

It is a corollary that the transmitted beam

should register defects upon a photographic film with a contrast inferior to that obtained with the present radiographic X-ray wave lengths. This diminished contrast is an inevitable resultant of the shorter wave length, and is, of course, not peculiar to the radia-

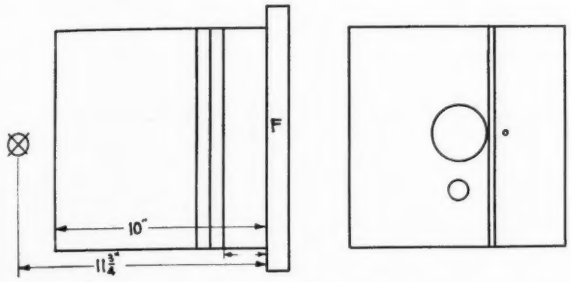


Fig. 33. Diagram showing method of preparing specimen radiographed in Figure 34.

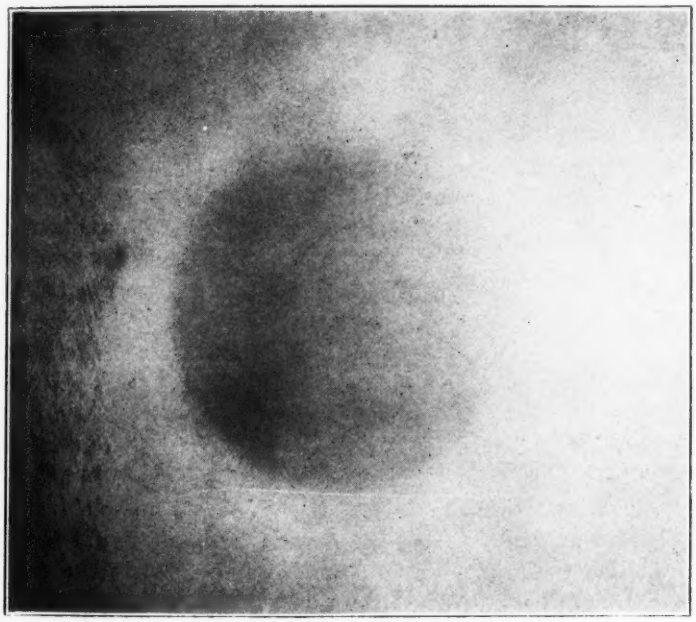

Fig. 34. Pile of steel plates, total thickness 10 in., with holes and slots in two plates, as indicated in Figure 33. The positions of the two plates bearing the holes and slots are indicated in the 10-in. section in Figure 33. The rest of the section was made up of plain plates (Film No. 16). Distance, source to film, 12¼ in.; intensifying screen, none; time of exposure, 10¾ hrs.; mean strength of emanation, 2,100 millicuries in six bulbs. *Results:* Under-exposed. Another film, taken simultaneously with two Patterson screens, had nearly correct density for viewing by reflected light when backed by white paper; by mistake, the poorer of the two was sent for reproduction (authors' note). On both, the hole 3 in. in diameter by 1½ in. deep is shown clearly, while the hole 1 in. in diameter by 1½ in. deep is barely seen. On the better film both slots are faintly recorded. The ¼-in. holes do not appear. A single bulb, with a correspondingly longer time, would have considerably improved the definition in this and several other films.

tion originating from the decomposition processes in radium emanation; development of higher voltage X-ray radiography would lead to a similar circumstance.

It was also indicated in the Introduction that the scattering of γ-rays (Fig. 4) should not be inimical, and that, in fact, the almost complete absence of "back-scattering" (scattering at an angle of 180 degrees and thereabouts to the primary beam) is an especially favorable feature of γ-rays, for it is unnecessary to take the precautions (various types of shielding) which are a necessary part of X-ray radiography. It may be said that the experiments performed appear to bear out these views.

Radiographs have been taken of objects the thickness of which exceeds that thickness now possible to radiograph with X-rays within reasonable exposure times, that is, from four to ten inches of steel. The minimum exposure times for such thicknesses have not been defined. If it should appear desirable to develop a γ-ray radiographic method for practical use, it will be necessary to work out a correlation of strength of source, time of exposure, and photographic result. In such an eventuality especial attention will have to be given to methods by which the exposure time, at best rather long with γ-rays, can be reduced to a minimum.

As to be expected, enhancing screens (of calcium tungstate) are very effective in reducing exposure times, though the actual saving in time has not been defined. Lead foil likewise proved effective in shortening exposure times. The use of multiple films is effective in making visible to the eye dimly developed images, and this technic is to be recommended to eliminate from consideration possible spurious effects originating in defective films. It has been found very useful to view the developed film in good light upon a piece of white paper. The enhancing effect of this device is startling. Film No. 13 (Fig. 27) was photographed in this way.

The diminished contrast is illustrated especially by Figures 14 and 15 and Figures 21 and 22. This diminished contrast is not necessarily an argument against the use of γ-rays, especially in the upper ranges of thickness, but it means that importance must be given to slight density discontinuities on the developed film. No detail shown in Figure 14 is absent from Figure 15; it merely appears with diminished contrast. This diminished contrast originating in a lower absorption coefficient has one advantage: it facilitates the radiography of irregular sections, for it is an easier matter with γ-rays to obtain the whole of an irregu-

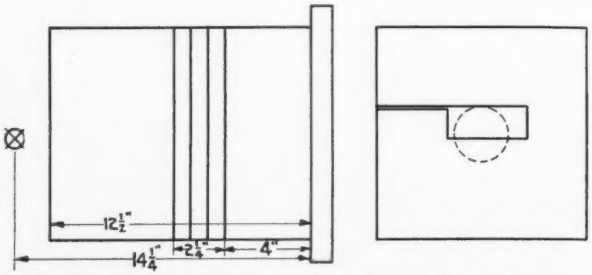


Fig. 35. Diagram showing method of preparing specimen radiographed in Figure 36.

lar object at a correct exposure than it is with X-rays. This, likewise, is shown by Figures 14 and 15.

Although no efforts were made to prevent scattering in these experiments, no poor results were obtained which could be ascribed to this cause. Thus Films No. 3, 11, 15, and 17 were made simultaneously, as were Films No. 12, 13, and 16, with the objects close together and several of them of very considerable mass, yet fogging appears to be unimportant on these films. This, taken with the fact that portions of the film exposed to the primary beam are not so badly overexposed when $\gamma$-rays are used as when X-rays are used, explains the lack of halo at the edges of the specimens.

The sensitivity of the $\gamma$-rays towards small defects seems satisfactory, though in the absence of extensive experimentation there may be some uncertainty on this score. Despite the fact that Film No. 9 was taken upon a "synthetic" specimen, the certain identification of a slot only 2 per cent of the total thickness is promising. The discovery of the defect in the cast iron block upon Film No. 15 was, of course, somewhat gratifying.

The above discussion is all built upon the photographic registration of the transmitted beam. For reasons already given it is believed that fluoroscopic methods are not feasible and that at present the photographic method is superior to methods by which the intensity of the transmitted beam is registered by means of its ionizing effect.

Fig. 36. A series of steel plates having a total thickness of 12½ inches. All the plates were plain except three near the center, as indicated in Figure 35. Two of these were the plates illustrated in Figure 33, the third illustrated on the right of Figure 35, which shows the alignment (Film No. 17). Distance, source to film, 14¼ in.; intensifying screen, one Patterson screen on each of two films; time of exposure, 10½ hrs.; mean strength of emanation, 2,181 millicuries in six bulbs. *Results:* Under-exposed. The photographic reproduction was done with rear illumination with two films (taken simultaneously) superimposed. The films were held at an angle during reproduction in an attempt to bring out more strongly the dark area in the center. Within the range of intensities and exposure times available during these experiments, this film shows that the thickness for satisfactory radiographs has been exceeded. Our opinion is, however, that a longer exposure and a source of smaller dimensions would allow this and probably greater thicknesses to be radiographed.

The practical features surrounding the use of γ-rays for radiography are so greatly different from those of X-rays that care must be taken in comparing practical application of the two methods.

The technic of γ-ray radiography is extremely simple. There is required merely a source of γ-rays of suitable strength (radium or radium emanation) mounted simply (Fig. 6, for example), the object to be radiographed placed at a suitable distance—defined by the strength of the source, the thickness of the object, the exposure time desired, and the definition required—and a photographic film, with or without intensifying screens, placed behind the object.

During the exposure no attention need be given and the operator may leave, returning at the expiration of the necessary exposure time. There is, of course, no high voltage equipment to be attended, nor are there any permanent high voltage leads to the source. In fact, the set-up could be arranged at almost any conceivable place, for everything is entirely portable and rugged.

The emission of γ-rays cannot be controlled. Whether or not the radio-active source is being used for radiographic purposes, it will continue to emit γ-rays. It would be advisable, therefore, to make as continuous use of the source as possible during the time it is in the possession of the operator.

Since γ-rays are emitted in all directions —that is, spherically—the source might be completely surrounded by objects to be radiographed. Because of the inverse square law governing the diminution of the intensity with distance from the source, it is unimportant whether a large number of objects be radiographed at a considerable distance with a long time of exposure, or a small number at a short distance with a brief time of exposure; in either case the profitable use made of the γ-ray would be the same, with the qualification that a greater degree of definition would be obtained at the greater distances.

With a constant source of γ-rays and a large number of objects of varying dimension to be radiographed suitable exposures might be obtained either by varying the time of exposure, or by placing the thinner objects at greater distances and keeping a constant time of exposure for the whole arrangement. This latter scheme was followed in preparing Films No. 3, 10, 15, 17 and Films No. 12, 13, 16.

In the use of γ-rays, as in the use of X-rays, protection must be given the operator against the harmful effects of the rays. It would hardly be useful here to describe in detail the precautions the medical profession has found necessary, except possibly to mention those affecting the technic of operation. Distance, of course, is the best protection, and since no attention during exposure is required, this requirement may easily be met. The emanation is usually transported in a small but heavy-walled lead box and the emanation handled with forceps. These are probably the only details to be mentioned. The authors have been assured by medical practitioners that there should be no objection to the use of γ-rays for the purpose suggested here, originating in possible harmful effects to the operator.

ACKNOWLEDGMENT

The authors wish to express their obligation to a number of persons who rendered valuable assistance during the course of this work: to Dr. Howard A. Kelly, of the Howard A. Kelly Hospital, Inc., of Baltimore, Md., who granted us permission to make use of his supply of radium emanation, and especially to Dr. F. West, Superintendent of the hospital, who attended to our various needs during the work with the greatest of consideration and helpfulness; to Prof. A. F. Kovarik, of the Department of Physics, Yale University, who discussed the problem with us previous to the begin-

ning of the work; to Dr. H. H. Lester, of the Watertown Arsenal, Watertown, Mass., who rendered assistance from time to time during the work; to Prof. J. B. Hoag, of the Department of Physics, University of Chicago, who made some preliminary experiments for us upon photography with γ-rays; to J. T. Gow, of this Laboratory, who lent assistance in many ways during the prosecution of the work, and finally, to Captain E. G. Oberlin, U. S. N., whose sympathy with research made this work possible.

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**The Radiophysiological and Medical Sections of the Radium Institute of the University of Paris. Cl. Regaud. Radiophysiologie et Radiothérapie, 1930, Vol. II, Fasc. 2, p. 157.**

The main value of this paper lies in a detailed discussion of the requirements for an efficient organization for the treatment of disease by radiations. The author emphasizes the fact that X-ray diagnosis and therapy are separate and distinct branches of medical science, while X-rays and radium are ever becoming more closely associated, particularly in the treatment of malignant disease. It is undesirable that an institute for radiation therapy should be limited to the treatment of cancer, but benign conditions which are capable of radiation treatment should also be included. The organization should include an efficient pathological and experimental service, and facilities should also be available for surgery. All departments should be under the control of specialists in the appropriate branches. Finally the necessity is stressed for a well organized secretariat which should have charge of all the clinical, pathological, and other notes relating to all patients, and should be responsible for insuring the regular follow-up of patients.

WALTER M. LEVITT, M.B., D.M.R.E.

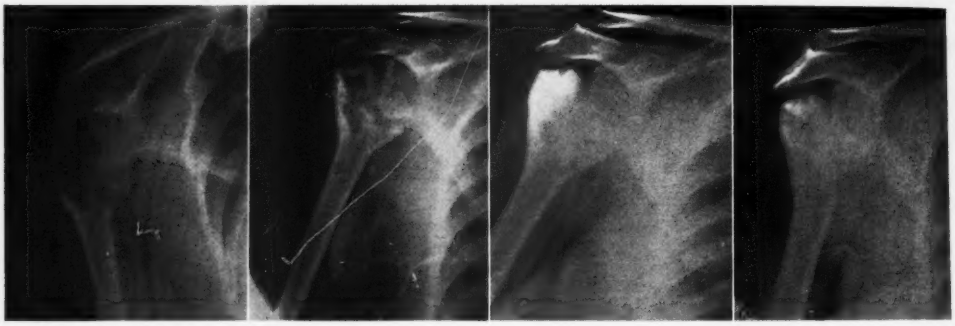
# X-RAY TREATMENT OF BONE METASTASIS[1]

By CASSIE B. ROSE, M.D., Presbyterian Hospital, CHICAGO

ALL investigators agree that the best treatment of malignancy now known is early and complete removal when this is possible. Since this is, every so often, impossible, many other methods of treatment have been devised. Of all the therapeutic measures, other than surgery, which have been tried, such as caustic pastes, active cautery, various sera, etc., radiation in the form of X-ray and radium has taken an outstanding place and seems to offer the most hope. It has proved so efficacious in skin cancer that it effects real cures in more than 90 per cent of the cases, when given fairly early and in sufficient dosage. The cure of deep-seated cancers by radiation has not yet been solved. The combination of radiation with surgery gives from 25 to 30 per cent better results in all types of cases than surgery alone, according to the statistics of various clinics (1).

Medicine should *relieve suffering*, both mental and physical. Radiation surely gives relief from pain, together with hope and mental comfort to many of these unfortunate sufferers, ever increasing in number, even though it may not produce permanent cures.

In 1916, Pfahler, of Philadelphia (2), first reported cases in which, following radiation therapy, bone destroyed by metastatic carcinoma recalcified, with corresponding clinical improvement. A few similar cases have been reported since.



Figs. 1-*A*, 1-*B*, 1-*C*, and 1-*D*. Case 1. Metastasis in the head of the humerus from breast carcinoma, showing progressive evidence of calcification.

I believe it is well to re-emphasize this effect of radiation.

My experience with metastatic carcinoma in bone either from breast, prostate, or other source, includes 50 cases. In analyzing the results, I have satisfied myself that, although this treatment does not cure, it prolongs life and relieves the sufferers of their pain to a surprising extent and often makes them able to enjoy life and participate in the activities of their home or even their business to such an extent that they feel the X-ray treatment has put them on

[1]Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1–5, 1930.

Fig. 2. Case 1. Multiple metastases in many bones.

their feet again. Out of this group of 50 cases I want to present to you a few as examples. All of these patients were in the Presbyterian Hospital, Chicago.

CASE REPORTS

Case 1. Mrs. G. T. was referred by Dr. D. B. Phemister. Tuberculous glands of the neck had been removed when the patient was 17 years of age, and again when she was 21 years old. When she was 36 years old her right breast was removed for carcinoma, proved microscopically. Six years later, that is, in 1924, she complained of severe pain in the left shoulder, at which time

Fig. 4. Case 2. Destruction in the left scapula, said to be a rare site for bone metastasis.

Fig. 3. Case 1. A pathologic fracture in the humerus, just below the old area of sclerosis.

X-ray examination showed destruction of the head of the humerus, undoubtedly a metastasis (Fig. 1-*A*). After two months of X-ray treatment, a film showed evidence of calcification. Subsequent films showed rapidly increasing sclerosis in the involved area (Figs. 1-*B* and 1-*C*). The patient's pain disappeared and she was able to use her arm normally; for instance, she could drive her car, can fruit, and sweep the floor.

Two and one-half years later, February, 1927, a roentgen film and clinical examination showed persistence of this good result (Fig. 1-*D*). In the Summer of 1927, while on an extended trip, the patient became lame and suffered from fleeting pains in various

parts of the body. Films taken in October showed multiple metastases to many bones (Fig. 2). Further X-ray treatment effected some recalcification, but never as marked as in the humerus and later some of it disappeared again. A pathologic fracture occurred in the humerus, just below the old area of sclerosis (Fig. 3). Although the patient was for the most part fairly comfortable, slept well, and retained her appetite, she went gradually downhill and died in February, 1929,—eleven years after her breast removal and four and one-half years after the bone metastasis was found in the left humerus. It would seem that the X-ray treatment during these four and a half years gave usefulness and comfort and freedom from pain instead of severe disability.

Case 2. Mrs. H. S. was referred to me for X-ray treatment in November, 1927, by Dr. H. L. Kretschmer. Two years after breast removal, severe pain appeared in the left shoulder and X-ray examination showed destruction in the left scapula (Fig. 4), said to be a rare site for bone metastasis (3). In addition, the third lumbar and the right ilium showed metastasis (Fig. 5).

Fig. 5. Case 2. Right ilium, showing metastasis.

Fig. 6. Bone repair in Case 2.

Bone repair occurred with fair rapidity, with corresponding improvement in clinical symptoms (Figs. 6, 7). During 1928 she was comfortable and able to look after her home and children. Recurrence, with loss of calcification and extension of the previ-

ously involved areas, occurred in 1929 (Fig. 8), with death in September of that year, two and a half years after the metastasis was discovered, and two years after X-ray therapy was instituted. During this time she was greatly relieved of her suffering, due, so far as I can see, to X-ray therapy.

Fig. 7. Bone repair in Case 2.

Fig. 8. Case 2. Recurrence, with loss of calcification and extension.

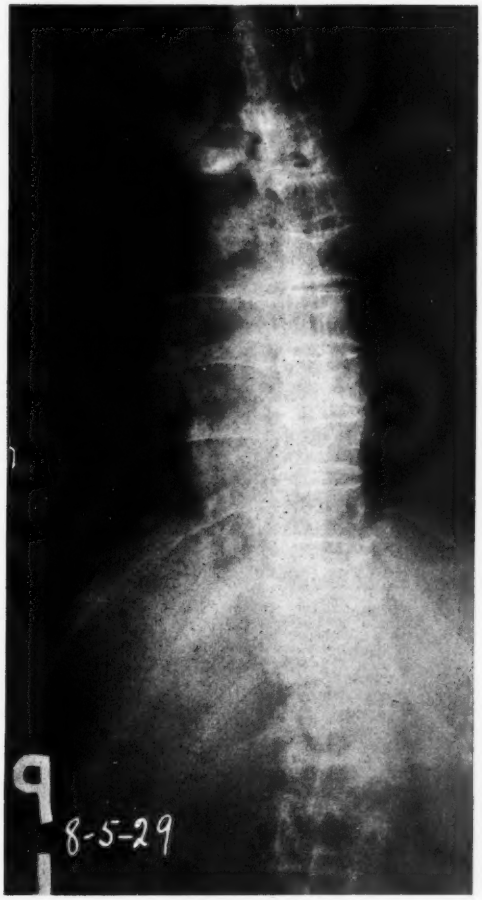



Fig. 9. Case 3. Partial collapse of the last three dorsal vertebræ, particularly the eleventh, and a fracture of the eleventh rib on the left, close to its articulation with the spine.

Case 3. The patient, Miss J. B., in December, 1913, five years after she had first noticed a bean-sized nodule in the right breast, had a radical resection done by Dr. A. D. Bevan, for carcinoma (proved microscopically). The nodule at this time was the size of an egg, and the axillary glands were involved. A few X-ray treatments were given post-operatively.

Ten years later, in 1923, the patient noticed a small nodule in the left breast. This grew in two years to the size of an English

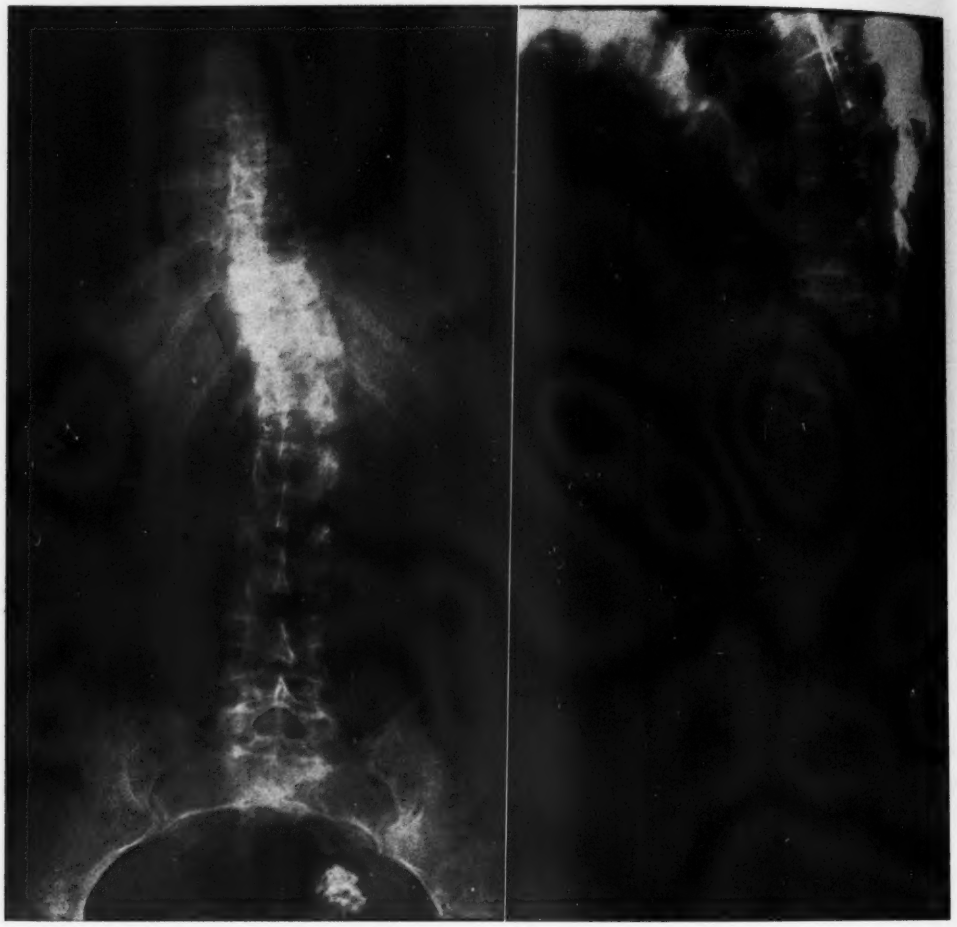


Fig. 10. Case 3. Following X-ray treatment, there was some increase in the density of the vertebræ.

walnut. In May, 1925, a radical resection of the left breast was done by Dr. Gatewood, and at the same time a recurrence in the right scar was removed. Again X-ray treatments were given, followed by a second series in 1926. In October, 1927, and June, 1928, a dime-sized recurrence appeared in the right scar, and each time disappeared following a short course of radiation. In January, 1929, this area again appeared and ulcerated and neither X-ray nor radium sufficed to close it entirely. In June, 1929, the patient developed pain in the legs, with difficulty in walking. In August an X-ray film (Fig. 9) disclosed partial collapse of the last three dorsal vertebræ, particularly the eleventh, and a fracture of the eleventh rib on the left, close to its articulation with the spine. After X-ray treatment the pain disappeared and films (Fig. 10) showed some increase in the density of these vertebræ. The patient returned to her work, but a month later the pain recurred, she became progressively

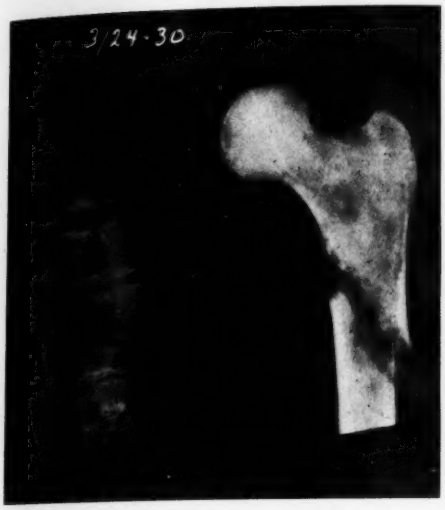



Fig. 11. Case 3. Autopsy specimens.

weaker, was confined to bed, but was fairly comfortable under mild sedatives. She died in April, 1930, twenty-two years after she had first noticed a nodule in her breast. A definite, although short, relief from pain and disability in walking was obtained through X-ray therapy, and there was some reformation of bone tissue.

Postmortem (Fig. 11) showed pathologic fracture of both femurs and carcinomatous involvement of the spine, together with multiple miliary metastases in many parts of the body. Microscropically, small spicules and buds of new bone were visible in the previously collapsed and radiated dorsal vertebræ. It is impossible to state whether this new bone was the result of X-ray therapy, or simply callus following fracture. In three other patients with similar metastatic involvement, who did not have X-ray therapy, such bone buds were not seen. Further study of postmortem evidence is needed.

Case 4. Mrs. C. D. was a patient of Dr. W. E. Post. Two years subsequent to the removal of the left breast, this patient, aged 36, delivered a full-term baby. In the latter

Fig. 12. Case 4. Bone destruction.

part of the pregnancy she complained of much pain in the pelvis and legs and was unable to walk. This was interpreted as pressure pain. However, it did not dis-

Fig. 13. Case 4. Calcification in areas of bone destruction.

Fig. 14. Case 4. Evidence of calcification.

appear after the delivery but grew progressively worse. The patient became unable to turn in bed without help, and then only with excruciating pain. Opiates gave only partial relief.

X-ray films (Fig. 12) taken in July, 1928, showed bone destruction of the left side of the sacrum, the right acetabulum, the third, eighth, eleventh, and twelfth dorsals, and first lumbar, also complete erosion with fracture of the seventh and eleventh ribs and many other small areas of rib involvement. In August, 1928, the patient was referred to me for X-ray therapy. Rapid relief of pain and calcification in the areas of bone destruction followed. In October she was comfortable; in March, 1929 (Figs. 13, 14), she was walking with a cane; a few weeks later the cane was discarded, and she was able to live her normal life. In January, 1930, she took a seventy-mile automobile ride without discomfort. Films at this time showed such complete regeneration of bone that the old areas of destruction were difficult to visualize.

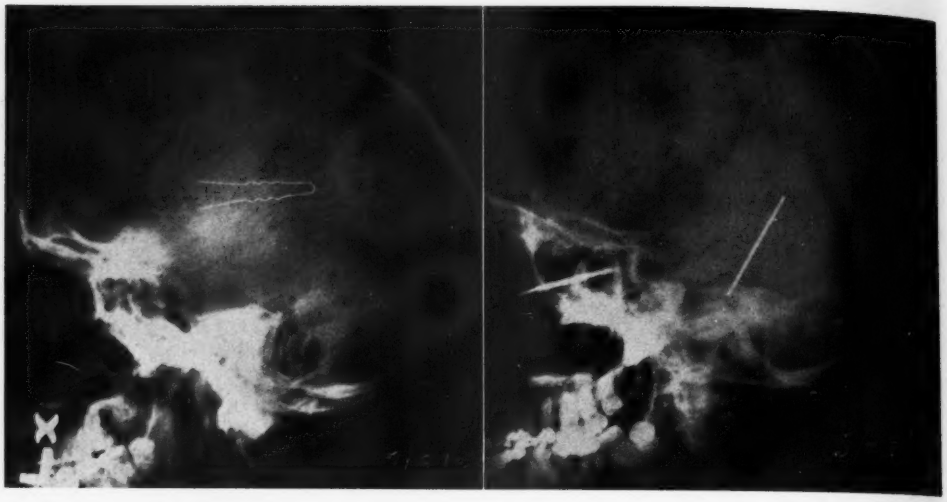
However, carcinoma developed in the other breast, and numerous firm nodules appeared in the skin of the neck and abdomen. Films (Figs. 15, 16, 17, 18) showed evidence of metastases to the bones of the skull, and the areas previously involved became a little less densely sclerosed, although the destruction was not nearly so marked as on the first films of this patient. In July she still was able to walk, though with less agility, and considerable nausea and vomiting had developed. On October 28, 1930, she died. During this time never more than four aspirin tablets in twenty-four hours were needed to control her pain, and on some days none were needed. No morphine was given except one dose the day before her death. At no time did she lose her *morale*. She had two full years of comfortable and useful life, instead of being bedridden and tortured with excessive pain, and I believe that the X-ray should be credited with this good result. Autopsy was not permitted.

Case 5. Mr. F. H. was a patient of Dr. H. L. Kretschmer. He was a man 74 years of age, who entered the hospital in March, 1927, complaining of prostatic symptoms of four or five years' duration and recent pain in the right leg, with difficulty in walking. A large hard nodular prostate was found. X-ray films taken in March, 1927 (Fig. 19), showed extensive destructive metastasis to the right side of the pelvis. A suprapubic cystotomy was done and X-ray therapy was started. Within two months the pain had disappeared and the patient went home. He returned six months later (in December, 1927), with recurrence of pain in the right leg. X-ray films (Fig. 20) showed some—not very marked—increased calcification in the previously involved area. Further X-ray treatment was given. Following this for a year the patient was perfectly comfortable and able to carry on his usual work, which involved many long motor rides. In December, 1928, he returned with pain in the left leg, but no pain had recurred in the right leg. A series of X-ray treatments re-

Figs. 15 and 16. Case 4. The areas previously calcified are less densely sclerosed.

lieved the pain. A film at the end of the treatment (Jan. 3, 1929) showed a heavy calcification in the right side, and numerous rounded areas of increased density in the left side of the pelvis (Fig. 21). Again he went home comfortable, but died some three or four months later. I believe the X-ray treatment gave to this man more than a year of comfortable, active business life which he would not otherwise have had.

Case 6. Dr. F. B., a patient of Dr. A. H. Montgomery, aged 61, was diagnosed in June, 1928, as having carcinoma of the prostate. Radium was given through the perineum four times. In August, 1929 (Fig. 22), an X-ray film showed multiple small rounded areas of faintly increased density throughout the bony pelvis. At the same time the patient was in severe pain—unable to turn in bed without help and then only with great difficulty. Opiates were not tolerated. Pantopon was tolerated fairly well and gave some relief. X-ray treatment was started. Within two months the patient was able to walk up and down the corridor of the hospital. A film (Fig. 23) showed a marked increase in the density of the small rounded areas seen on a previ-



Figs. 17 and 18. Case 4. Evidence of metastases to the bones of the skull.

ous film of the pelvis. A film in December showed still further sclerosis of these areas (Fig. 24). The patient was able to go home but returned in March with a nephritis of severe degree, which terminated in uremia in April. The severe bone pain did not return to any considerable degree. Subsequent films were not taken and autopsy was not permitted. I believe that the X-ray therapy gave this patient definite and

Fig. 19. Case 5. Extensive destructive metastasis to the right side of the pelvis.

Fig. 20. Case 5. Some—not very marked—increased calcification in the previously involved area.

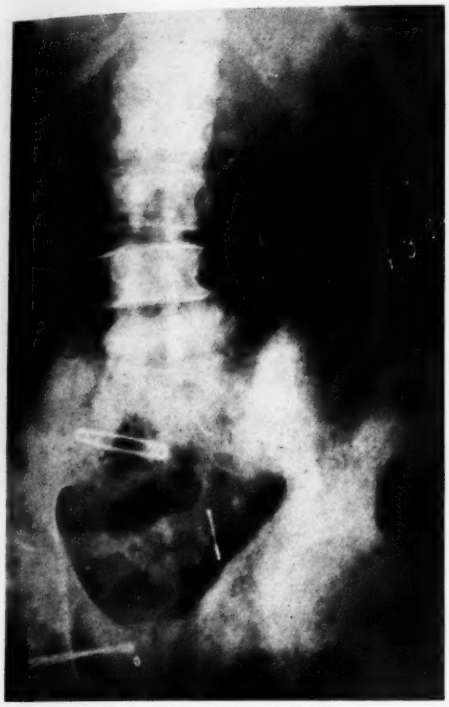


Fig. 21. Case 5. Film taken at the end of the treatment, showing a heavy calcification in the right side, and numerous rounded areas of increased density in the left side of the pelvis.

Fig. 22. Case 6. Multiple small rounded areas of faintly increased density throughout the bony pelvis.

Fig. 23. Case 6. Marked increase in density of the small rounded areas seen in Figure 22.

very welcome relief from the pain, which he was unable to get from medication.

For all of these patients I have used a routine treatment dose: 140 kilovolts, peak; 5 milliamperes; 10-inch skin target distance; ¼ mm. copper and 1 mm. aluminum filter; time, 10 minutes, covering an area 15 cm. in diameter. This dosage gives 35 r per minute. One area was radiated at each treatment, rarely two areas. Treatments were given, as a rule, two or three times per week, and were directed from various angles toward the areas of involvement. I did not treat the same area oftener than once in ten days or two weeks. Treatment was continued for a period of from four to six weeks, after which the patient was given a rest interval of from one to two months. After the patient became comfortable radiation was intermittent or even discontinued for several months. In one or two instances in which the patient came from a considerable distance, treatments were given daily for a period of two or three weeks.

Glucose, either intravenously or orally, usually in conjunction with calcium lactate,

Fig. 24. Case 6. Still further sclerosis of the areas shown in the previous figures.

was given to several of these patients for varying periods of time. In some instances it seemed to help, though I was never sure that it was of any considerable value therapeutically. If long continued, the patients developed a strong aversion to it. In the case with metastasis to the humerus, the patient was treated without glucose until the time of the late generalized metastases.

I am of the opinion that frequently repeated doses of X-ray of moderate voltage are sufficient, and, in the long run, give satisfactory results. In my experience comparatively little roentgen sickness has appeared.

Because clinicians in general and many roentgenologists seem to feel that when bone metastases occur the case is utterly hopeless, I am presenting these six cases as a plea that these patients be given the benefit of radiation therapy. This relief of suffering and the reformation of bone are the two factors which should make us look upon X-ray treatment as the greatest boon to the patient until medicine shall have found a cure for this disease, a part of which may be X-ray.

## REFERENCES

(1) Pfahler, G. E., and Parry, Leo D.: Results of Roentgen Therapy in Carcinoma of the Breast. Jour. Am. Med. Assn., Jan. 11, 1930, XCIV, 101.

(2) Pfahler, G. E.: Roentgen Diagnosis of Metastatic Malignant Disease of Bone, with Special Reference to Spinal Column. Am. Jour. Roentgenol., 1917, IV, 114.

(3) Bower, J. O., and Mengle, H. A. K.: Primary Carcinoma of the Left Breast Associated with Early Metastatic Involvement of the Right Scapula: Case Report. Am. Jour. Roentgenol. and Rad. Ther., April, 1930, XXIII, 415.

## DISCUSSION

Dr. Francis Carter Wood (New York City): I think Dr. Rose's paper is an excellent illustration of the purely palliative type of treatment with which we are all familiar. I think she has well stressed the very important point not to use high voltage radiation, which makes these patients very sick and does not improve the lesion any more than does the use of a moderate voltage, which is easily handled and is at everyone's disposal. The cases which I have seen treated with high voltage have usually done badly. My own practice is about that of Dr. Rose, repeated low voltage treatments giving about 60 or 70 per cent of an erythema or some 400 r units. I can, of course, only agree with her that many of these cases do extremely well; patients are able to get back to work and are freed from the necessity of taking drugs, and a little aspirin or a similar sedative will often carry them along to within a few weeks of their death. It is rather interesting to note that these patients who get bone metastasis rarely get pulmonary lesions; the ones that get pulmonary lesions die early and we can do little for them. The trouble is we rarely get these patients until the bones are invaded, and after some practitioner has

treated the patient for rheumatism, and thus time is lost. Such patients should be turned over to the radiologist, given light doses of X-ray over the lesion to prevent skin recurrences, and kept under observation. Radiation should be begun before bone changes are shown. The bone change is late and means absorption of calcium salts, but many patients have their bone pains early, and, if treatment is begun then, we get a much more satisfactory prolongation of life. The surgical profession is by no means aware of the fact, nor is the general practitioner, that a great deal can be done in the prolongation of life—two or three or four or five years—with a minimum amount of treatment, and of a type which does not annoy the patient.

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**Sunlight and Vitamin D. A. v. Wijk, E. H. Reerink, and W. Mörikofer. Strahlentherapie, 1930, XXXIX, 80.**

In previous investigations, the authors studied qualitatively the absorption spectrum of the products formed in irradiated ergosterol. They were able to determine the composition of an irradiated ergosterol solution from the absorption spectrum. The application of these results for a comparison of therapeutic lamps, suggested itself. It was necessary only to compare the amounts of Vitamin D produced in an ergosterol solution following exposure to various light sources. On that basis, the sun and a quartz mercury vapor lamp were studied. As a measuring instrument between 2,900 Ångströms and 3,100 Ångströms, the authors chose a cadmium photo-electric cell. In the solution exposed to sunlight, the Vitamin D was destroyed much quicker, and a secondary decomposition product appeared. Although it is not possible to compare the effects of the two light sources, expressed in identical units of energy, the authors state that the ratio between vitamin destruction and vitamin production in an irradiated ergosterol solution was from 0.137 (for the quartz mercury vapor lamp) to 0.34 (for the sun).

ERNST A. POHLE, M.D., Ph.D.

# MALIGNANT TUMOR OF THE ETHMOID[1]

By J. E. HABBE, M.D., MILWAUKEE, WISCONSIN

IN a paper before the Radiological Society of North America at Toronto, December, 1929, on the treatment of malignant tumors of the nasal accessory sinuses, Douglas Quick, of the Memorial Hospital, New York City, said: "It has been our unfortunate experience that radiographs for diagnostic purposes have not been as valuable as one might ordinarily expect, except in the very late stages where the differentiation is obvious to other and simpler means of examination. We feel that diagnostic X-rays have been of real value in only about 5 per cent of the cases."

In a discussion of this article, however, Pfahler said: "I believe that we should get help in 90 per cent of these cases of carcinoma involving the accessory sinuses."

The writer's personal experience in tumors involving the accessory sinuses has been too limited to warrant any statement as to the percentage of accuracy of the X-ray diagnosis of this condition. This single case is presented, however, as one in which the X-ray signs of malignancy were present some six or seven weeks prior to definite clinical findings.

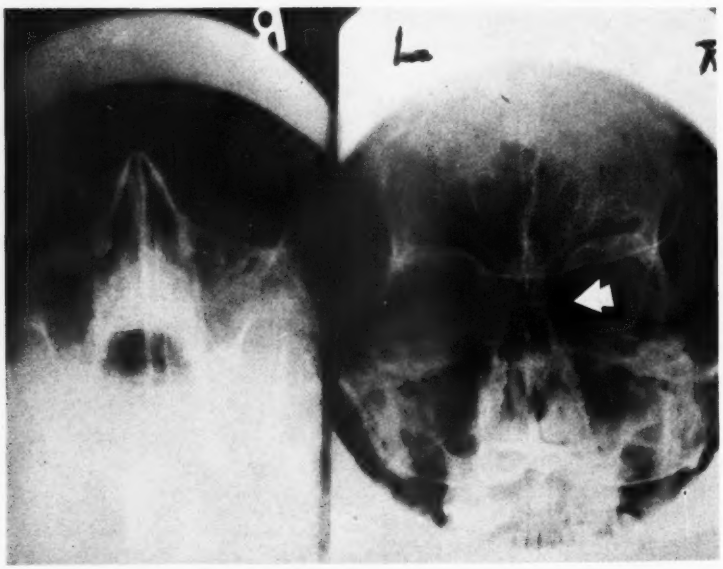

Fig. 1. Erosion of right lamina papyracea indicated by arrow. Seven weeks prior to possible clinical evidence of tumor.

## CASE REPORT

A man, aged 38, was referred for X-ray examination November 25, 1929, because of pain of recent origin in the right eye and temple. The patient also had some dullness in the head and a strained feeling in the

[1]Read at the mid-year meeting, Radiological Section, Wisconsin State Medical Society, May 23–24, 1930, Green Bay, Wisconsin.

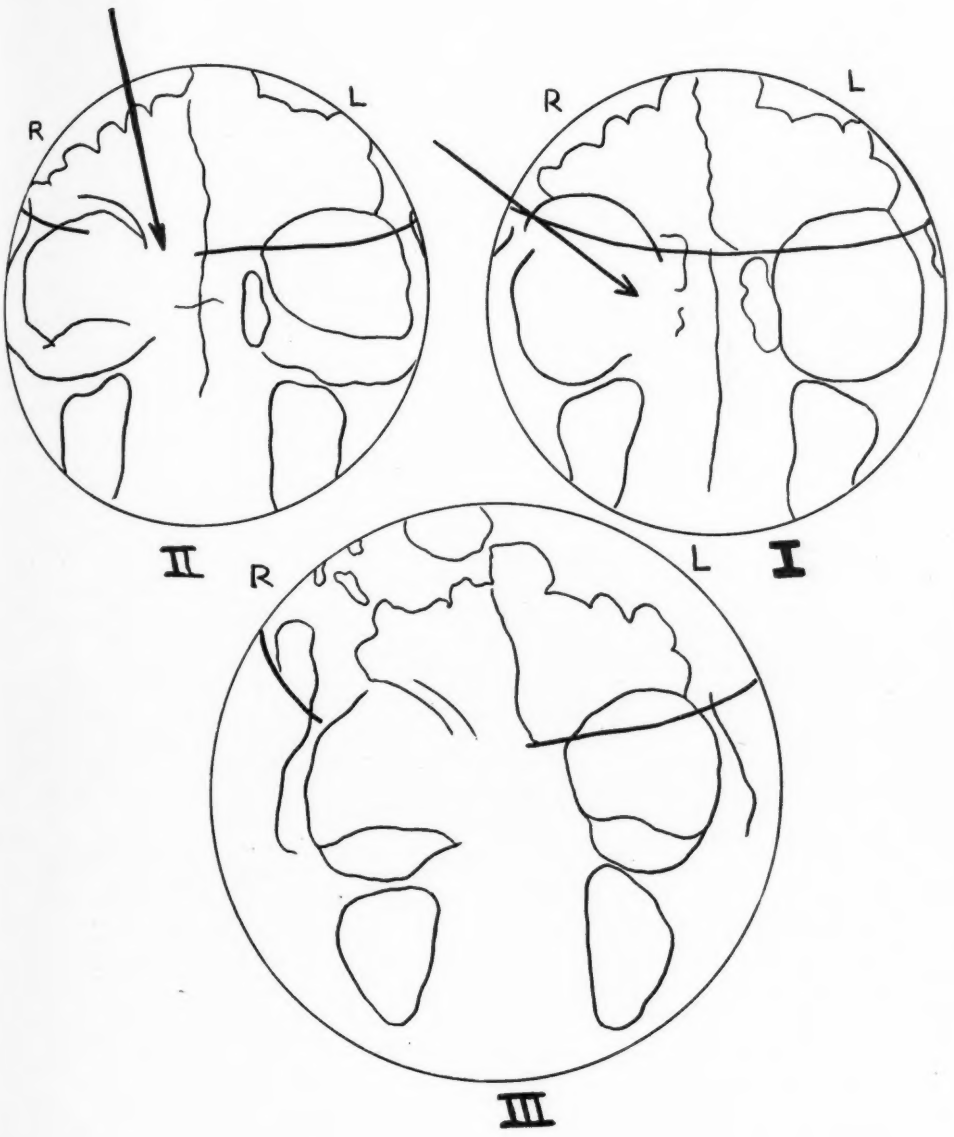


Fig. 2. Diagrammatic sketch showing (I) erosion of right lamina papyracea at first examination; (II) appearance seven weeks later, with additional destruction of right cribriform plate and portion of floor of anterior fossa; (III) final appearance following exploration and radium insertion into tumor-bearing area, one month prior to death.

eye, which symptoms were relieved by aspirin. A recent change in glasses had also given considerable relief. Rhinoscopy was essentially negative, but transillumination of the right frontal sinus and right antrum showed slight haziness, and by ophthal-

Fig. 3. Granger projection, showing marked right ethmoid clouding.

not remarkable, there having been occasional colds, and change of glasses—as might be in the past history of anyone, at the given age and in this climate.

On the day of the first X-ray study the clinician stated that there seemed to be a slight increase in ocular tension of the right eye, but there was no nystagmus or double vision.

The essential X-ray findings at this time were a slight diffuse clouding over the right ethmoid region, with loss of much of the bony detail of the cell trabeculæ and a portion of the medial orbital margin (that portion made up by lamina papyracea). The blotting out of the medial orbital margin shadow was best shown on the Caldwell film, the evidence of the ethmoid pathology was confirmed by the Granger projection,

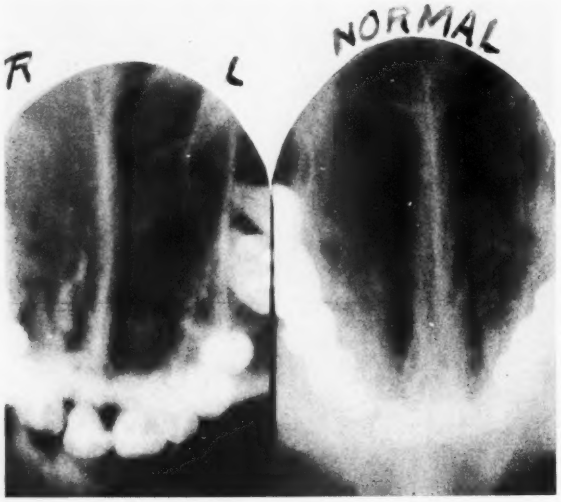


Fig. 4. Intra-oral film showing right ethmoid clouding, with disappearance of ethmoid-cell trabeculæ, especially in posterior ethmoid region. (Symmetrical appearance of ethmoids on intra-oral film shown on right.)

noscopic examination the discs were slightly hyperemic but were equally so on both sides and the margins were quite clear.

The past eye, ear, and nose history was

and the destruction of the ethmoid cell trabeculæ was most clearly shown on an intra-oral film taken with a Hayden cassette. Each of these three views was of distinct value

in arriving at a diagnosis of malignant disease involving the right ethmoid region.

The patient was seen in consultation by other clinicians, but the X-ray impression could not be clinically confirmed.

of a therapeutic test, for the patient suffered a moderately severe reaction in the way of marked increase in pain and repeated vomiting for a period of two or three days thereafter.

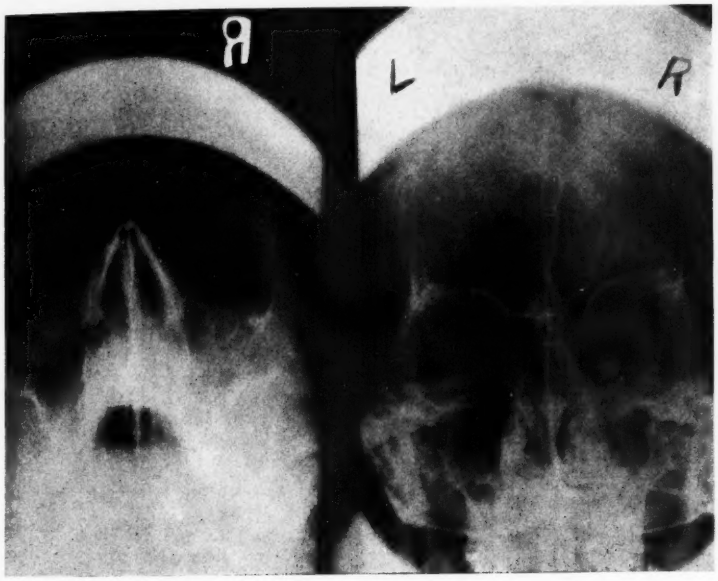


Fig. 5. Showing additional destruction of right cribriform plate at time of development of positive clinical signs of malignant tumor.

The question of X-ray therapy came up, but, following the recommendation of Sosman that roentgenotherapy in any case of intracranial tumor must be given with caution and rarely administered before an attempt has been made to extirpate or at least do a decompression, the advice was against therapy. However, because of increasing headaches and eye pain, a small dose, using a portal one inch in diameter, over the right ethmoid region anteriorly, was given on December 7, 1929, employing the following factors: 130,000 peak volts, 40 ma.-min., 12-inch distance, filter of ¼ mm. copper and 1 mm. aluminum (well under 25 per cent skin erythema in view of the small portal).

From the roentgenologic standpoint, the single X-ray treatment served as something

Within a few days of the treatment the patient had sufficiently improved from his reaction to warrant his travelling to another city, where he underwent a general study for some days, but again the original diagnosis of tumor could not be substantiated and treatment was outlined on the assumption that the patient's symptoms were in the nature of a sphenopalatine ganglion neuralgia.

He returned to his home and made some effort to resume his business but the pain and headache gradually increased and on January 13, 1930, when referred again for X-ray study (just seven weeks following the date of the original sinus X-rays), the clinician reported that the patient showed, for the first time, unilateral exophthalmos,

loss of central vision, and a bulging into the ethmoid region of the right nose. The X-ray findings at this examination were definite increase in bone destruction as manifested by a disappearance of the line representing the right cribriform plate.

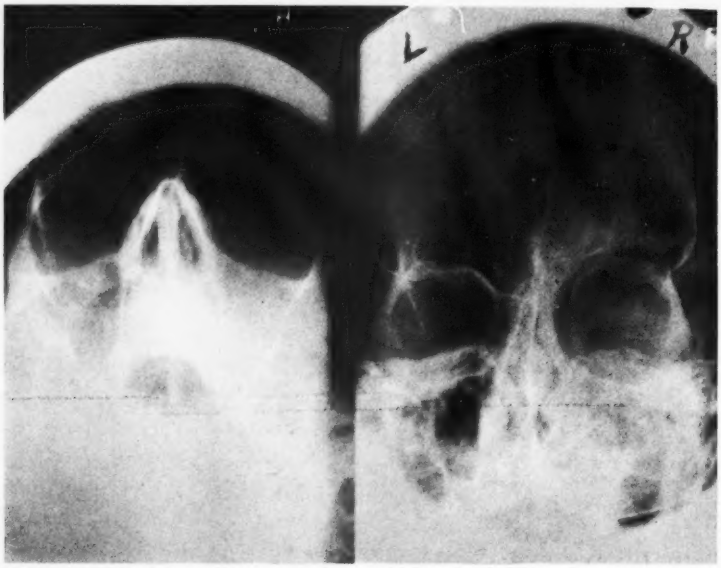


Fig. 6. Final examination following exploration and radium therapy. Death one month later.

A radical trans-frontal exploration of the right ethmoid region was made and tumor involvement of the ethmoid labyrinth was found, the microscopic diagnosis being epithelioma graded three. The origin of the tumor could not be determined. Radium was inserted into the operative wound and left sufficiently long to give an intensive dose of filtered rays.

Again the patient returned to his home and again made some final effort to resume his business, but the pain became worse and the vision was lost in the affected eye.

Final X-ray studies were made on March 28, at which time even more extensive destruction of the right orbital margin was found, and multiple areas of destruction in the right frontal bone were also shown, which were attributed entirely to tumor extension, although undoubtedly the evidences of right frontal and maxillary sinusitis may have been in some part an evidence of radium reaction.

The patient died April 27, 1930, just five months after the first definite diagnosis of malignant tumor had been made.

## CONCLUSION

A case of epithelioma involving the right ethmoid region is reported, in which definite X-ray evidence of an invasive lesion, with destruction of the ethmoid cell trabeculæ and the lamina papyracea, was demonstrated some seven weeks prior to positive clinical signs of tumor. The tumor grew rapidly despite intensive radium irradiation from within it, and death ensued

within five months of the time the original diagnosis of tumor was made.

The author wishes to thank Dr. H. G. Martin and Dr. T. L. Tolan for kindly supplying the clinical findings, and Mr. Leo Massopust, Marquette Medical School artist, for the reproductions and diagrammatic sketches.

BIBLIOGRAPHY

1. Bailey, Percival, Sosman, Merrill C., and Van Dessel, Arthur: Roentgen Therapy of Gliomas of the Brain. Am. Jour. Roentgenol, and Rad. Ther., March, 1928, XIX, 203.
2. Pfahler, George E.: Discussion of Quick, Douglas. Radiology, March, 1930, XIV, 243.
3. Quick, Douglas: Treatment of Malignant Growths of the Nasal Accessory Sinuses and Nasopharynx. Radiology, March, 1930, XIV, 191.

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**The Relation between Division Rate and the Radiosensitivity of Cells. Charles Packard. Jour. Cancer Research, August, 1930, XIV, 359.**

The author irradiated *Drosophila* eggs whose rate of cell division can be controlled by temperature. The eggs had been kept at the desired temperature for thirty minutes or more before radiating and during radiation. The temperatures employed were 13°, 23°, and 28° centigrade. The dose of X-rays in each instance was 150 K.V., 5 ma., at 40 cm. distance. Measurements showed that the intensity of the beam falling on the eggs was 17.0 r-min., including the scatter from the water and the walls of the chamber. The filtration was 0.25 mm. of copper and 1.0 mm. of aluminum. After 5, 10, 15, and 20 minutes of radiation, samples were removed and incubated in a moist chamber at room temperature. The percentage of eggs which hatched was considered an index of the effect. The author concluded that susceptibility rises as the rate of division at the time of exposure increased. The two curves, however, are not parallel.

*Drosophila* eggs were irradiated at room temperature and immediately afterward divided into two lots, one incubated at 18° and the other at 28° centigrade. The sensitivity of the chilled eggs was 89 per cent of that of the eggs reared at room temperature; the sensitivity of the warmed eggs was 110 per cent. This difference exceeds by far the limits of ordinary variation.

The author concluded that the activity of cells after exposure is also a factor in determining the ultimate injury sustained. The effect is lessened when the activity is decreased.

John R. Carty, M.D.

# CASE REPORTS AND NEW DEVICES

## HEAD CLAMPS FOR A FENESTRATED SHIELD FOR ROENTGENOGRAPHY OF THE NASAL ACCESSORY SINUSES

By MRS. J. D. BLOCHER
Section on Roentgenology, The Mayo Clinic
ROCHESTER, MINNESOTA

An improvement has been made on the fenestrated shield described in RADIOLOGY, February, 1928, X, 163. The shield presented here consists of a lead plate 1.15 mm. thick, faced on each side with a sheet of brass 0.4 mm. thick, making a composite plate with a total thickness of 1.95 millimeters. The mask is large enough to cover an 8 by 10 cassette exactly, and has a flanged edge to prevent any displacement. Two disks have been cut out of the mask, leaving two circular apertures, spaced 12 cm. center to center. These disks fit the openings in the mask exactly, one being kept in place while an exposure is being made through the opposite side. Each disk has a rivet soldered in the center to facilitate handling.

The improvement comprises two metal wings adjustable on a common sleeve, which, in turn, is mortised and movable on a square bar. The ends of the square bar are secured in the upper ends of two brackets permanently fastened to the shield. The metal wings extend 15.2 cm. from their supporting hubs, broadening from a width of 3.17 cm. at the hub to 6.03 cm. at the outer ends. They are 1.58 cm. thick, with edges and corners rounded. The hubs are fitted to slide easily for adjustment over the sleeve and are anchored in position by thumb screws.

The cylindrical shape of the sleeve permits the wings to be moved vertically and fastened in position as desired. The sleeve slides easily for lateral adjustment and is held in position by a thumb screw fitted into

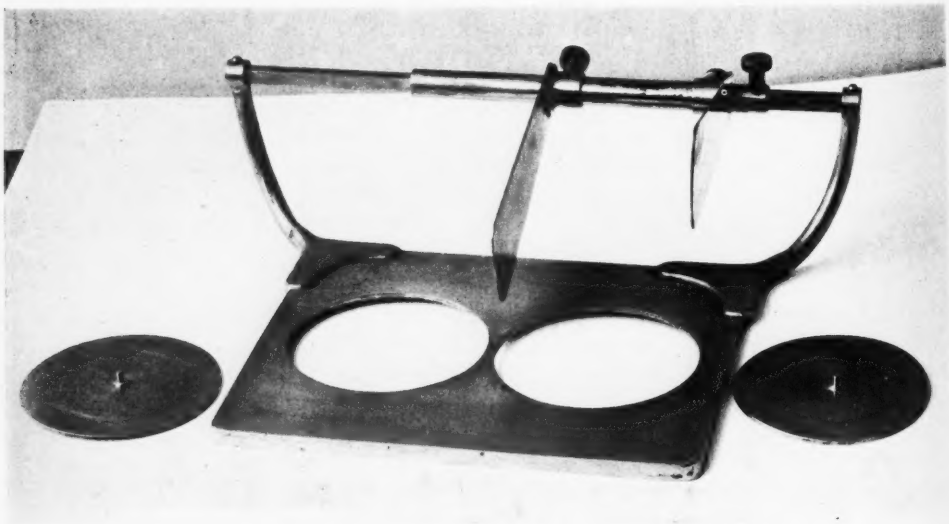

Fig. 1. The mask, with disks and head clamp.

one end. The fact that the square bar is stationary and is permanently secured to the two brackets, permits the sleeve and wings to be easily located and fastened in proper position. The brackets extend at 45° outward 6.98 cm. from, and 8.89 cm. above,

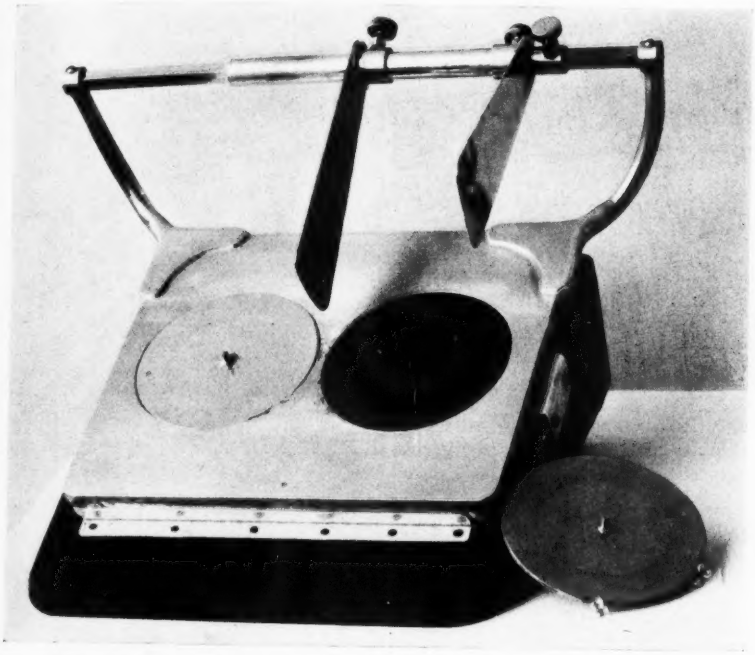

Fig. 2. The cassette, covered with the mask, placed on sinus board.

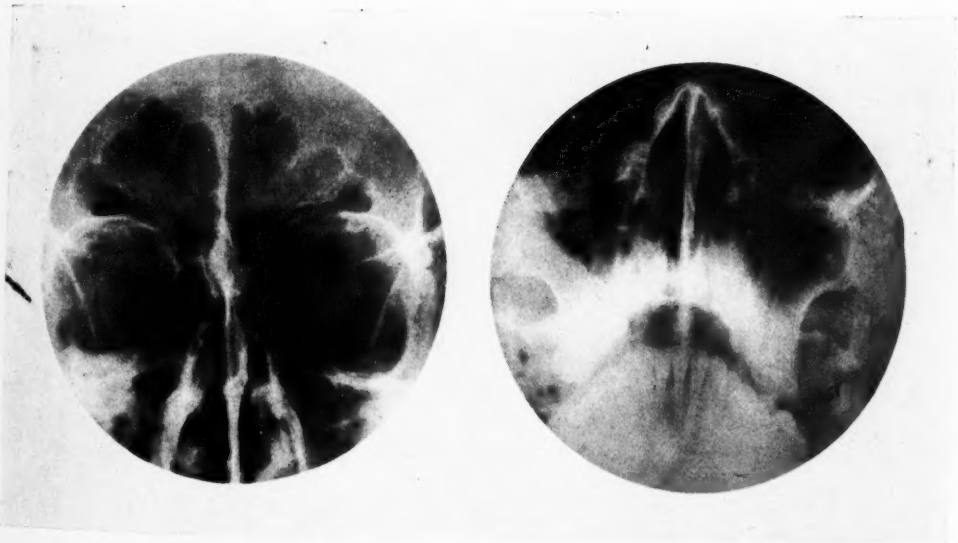

Fig. 3. Exposures made by the use of the mask; the nasal sinuses.

the top of the shield and are 38.1 cm. apart. The sleeve is of 1.74 cm. outside diameter and is 22.86 cm. long. The wing hubs are mortise to receive the ends of the bar which are held by a No. 8-32 machine screw in each.

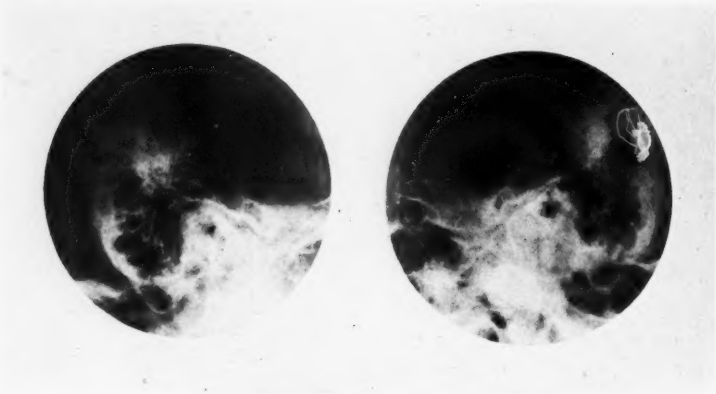

Fig. 4. Exposures made by the use of the mask; the mastoid regions.

2.54 cm. long and 2.22 cm. in diameter. The bar is 0.952 cm. square in cross-section and 40.64 cm. long. The upper ends of the brackets are 1.40 cm. in diameter and 1.27 cm. long, each having a 0.952 cm. square

Although this instrument was devised previously for roentgenography of the nasal sinuses, it has been found of equal utility in the making of roentgenograms of the mastoid regions.

## REPORT OF A PATIENT WITH EWING'S SARCOMA[1]

By E. ERIC LARSON, M.D.,
Los Angeles, California

The patient, Mrs. H. B. P., aged 23, employed as a cashier, married six months, was seen Oct. 17, 1930. Her complaint was that of constant boring pain in the upper part of the left femur, with marked swelling, and progressive loss of weight.

She stated that eleven weeks previous to this initial examination, after a game of tennis, she felt that a lumbar vertebra was out of place. This was adjusted by an osteopath who, at the third and last treatment, gave her legs a vicious jerk. Two days later the patient noted pain in the upper portion of the femur, with a noticeable swelling anteriorly. Her physician found a slight fever, but could not ascertain the cause of her trouble. After the patient had taken medicine for a time the pain disappeared, but the swelling progressed. Two months later, after a horseback ride, the pain recurred and persisted. At this time the blood count was normal. X-ray examination of the left femur and thigh was reported negative. The patient spent three weeks in bed, complaining of pain, tenderness, and progressive enlargement of the tumor, with slight fever; then she consulted us for an opinion as to the cause of her distress and suggestions for relief.

Physical examination revealed a slender young woman, weighing ninety-five pounds,

[1]Presented before the Radiological Society of North America, at the Sixteenth Annual Meeting, at Los Angeles, Dec. 5, 1930.

Fig. 1. X-ray film taken Nov. 5, 1930, shows suspicious defect in the upper portion of the femur. In the soft tissues around this defect can be seen a shadow of the tumor.

Fig. 2. X-ray film taken Nov. 19, 1930, definitely reveals the defect in the upper portion of the femur. It has also increased in size and has the appearance of an osteomyelitis.

who said that she had had a loss of fifteen pounds during the past eleven weeks. She was pale and looked ill. The left thigh was quite swollen, with no apparent demarcation of the tumor. The mass appeared to be semi-solid in consistency, with a generalized tenderness over the whole area of swelling.

Blood analysis revealed 4,400,000 erythrocytes and hemoglobin of 12.5 gms. (72.6 Sahli); 9,100 leukocytes differentiated as neutrophils 53 per cent; eosinophils 1 per cent; large lymphocytes 44 per cent; mononuclears 1 per cent. The coagulation time was four minutes. The blood Wassermann was negative.

X-ray examination of the left femur revealed a very slightly suggestive lesion in its upper third. No definite diagnosis could be made from the X-ray studies (Fig. 1).

A diagnosis of hematoma, osteomyelitis, or sarcoma was made and exploration advised. Accordingly, on Oct. 21, 1930, the anterior aspect of the thigh was opened, just over Scarpa's triangle. By blunt dissection down to the periosteum there was encountered near the bone what appeared to be an organizing blood clot about 5 cm. in diameter. This was carefully swabbed out and, since no other mass could be felt and the periosteum seemed intact, we were of the opinion that we were dealing with a hematoma. The wound was closed, a rubber drain inserted which was removed on the fourth day, followed by prompt healing. The blood clot was cultured and also examined under the microscope, and was reported negative.

On Nov. 20, 1930, because of increased swelling and pain, it was found necessary again to explore the thigh. The X-ray examination showed that the original defect in the femur had become larger in extent and

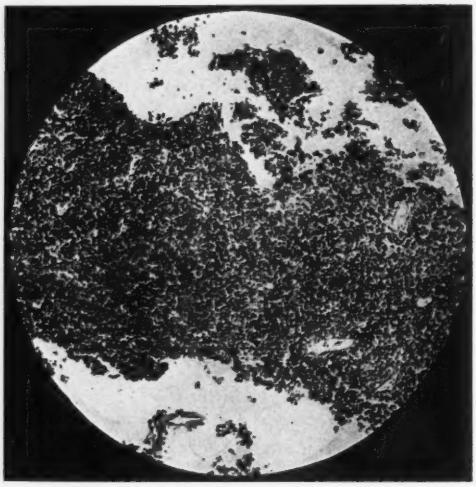

Fig. 3. Specimen consists of soft gray and hemorrhagic tissue. Rapid frozen section made. Opinion given as malignant tumor. *Microscopic report:* Sections show a tumor made up of large pavement-like sheets of small polyhedral cells, grouped around capillaries and blood vessels. There is practically no supporting connective tissue. The cytoplasm is pale and stains very poorly or not at all. The nuclei are round or oval and relatively pale; the nucleoli are indistinguishable Mitoses are numerous (five or six in some high-power fields). In many places there is extensive necrosis. We are of the opinion that this is a Ewing's sarcoma. *Diagnosis:* Ewing's sarcoma.

appeared to be more suspicious of malignancy (Fig. 2). Accordingly, another incision was made on the antero-lateral aspect of the thigh and there was removed a large quantity of bloody, gelatinous tissue, malignant in appearance. The pathologist's report was Ewing's sarcoma (Fig. 3). Immediately twenty-one platinum needles containing radium were inserted into the wound by Dr. William E. Costolow. After four days the needles were removed. The wound healed by first intention. The tumor mass disappeared.

On Jan. 15, 1931, the patient was examined and there was found to be no recurrent swelling or pain in the leg. The patient refuses further X-ray or radium treatment.

## FLUOROSCOPIC-RADIOGRAPHIC CHANGE SWITCH

By ROBERT B. TAFT, M.D., B.S.
CHARLESTON, SOUTH CAROLINA

It is rather unfortunate that manufacturers of X-ray apparatus in America make no provision in their equipment for the rapid change from fluoroscopic to radiographic settings, as in many instances a change of that kind is of great value. The routine in gastro-intestinal work is greatly facilitated if films can be conveniently made at any time during the fluoroscopy. Lesions of the esophagus are more readily filmed in the same position which best showed the pathology fluoroscopically. An appendix may show only when pressure is used over the cecum. These and many other conditions are readily met by placing a cassette between the patient and the fluoroscopic screen, the only difficulty being that of making the necessary changes in the setting of the machine.

An instrument which accomplishes this change must incorporate the following features:

1. It must increase the milliamperage by increasing the current to the filament.
2. It must make provision for sustaining the kilovoltage when the milliamperage is increased.
3. It must set up the time switch.
4. It must be operated by some simple movement of the hand or foot of the operator.
5. It must return the machine to the usual fluoroscopic setting after the exposure is made.

The author's switch accomplishes all of the above when the operator pulls on a cord, and, after the exposure is made by the foot switch, returns the machine to the fluoroscopic setting when the cord is released.

The extreme simplicity of this instrument makes failure practically impossible. As

the diagram, Figure 1, shows, it consists essentially of a gang switch of special design, bolted inside the control cabinet of the X-ray machine, and is operated by a pull cord fastened to the handle which projects through the side of the cabinet. The three brass rings are all mounted on a bakelite rod and insulated from each other and from the central shaft. Spring brass brushes are so arranged that they make contact with the rings when the switch is pulled into active position.

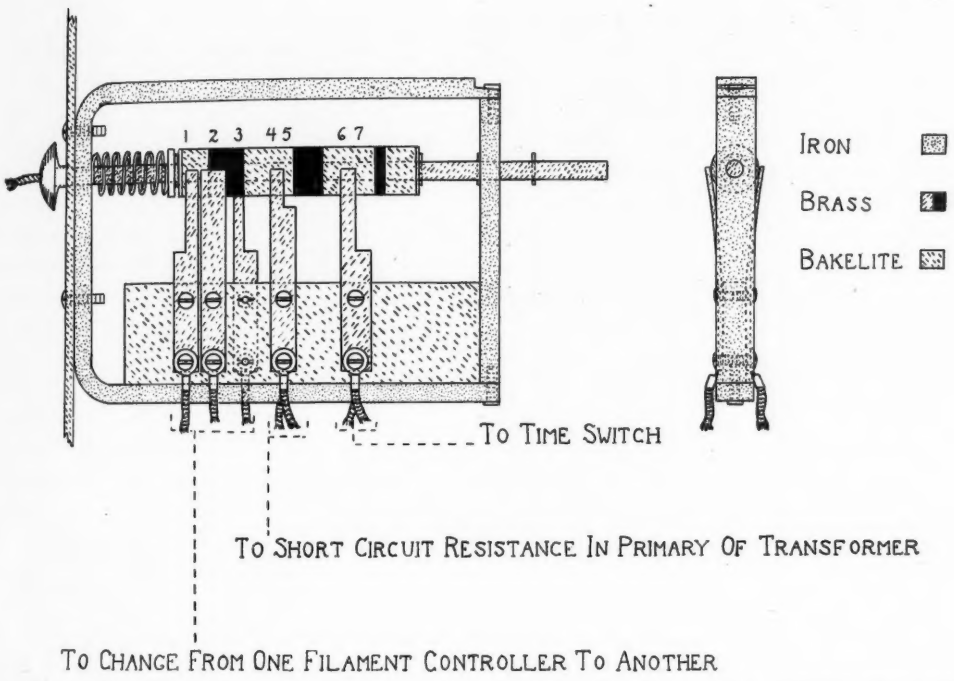
1 2 3 4 5 6 7
IRON
BRASS
BAKELITE
To Time Switch
To Short Circuit Resistance In Primary Of Transformer
To Change From One Filament Controller To Another

Fig. 1. Drawing of the switch in the fluoroscopic position. The instrument is mounted inside the control cabinet of the X-ray machine and the knob on the left extends through the side of the cabinet. It is operated by a pull on the cord, and is returned to the fluoroscopic position after the pull is released, by the coil spring.

The diagram shows the switch in the fluoroscopic position where Brush No. 2 is connected electrically with No. 3, these two being connected in series with the filament controller on the X-ray machine. This allows the current to flow to the controller just as if the switch were not there. When the switch is pulled to the left, No. 2 is disconnected from No. 3 and connected to No. 1, cutting in another filament controller which has been set up to the desired milliamperage. Thus the problem of milliamperage is met. A wire-wound rheostat answers the purpose well for this extra controller.

Brushes No. 4 and No. 5 are connected together electrically when the switch moves to the left and short the resistance in the primary of the transformer. This has the effect of changing from the "Limited" to the "Full" capacity on the KK disc rectifier machine. On a machine of other make it would be used to short that part of the resistance which was used for fluoroscopy.

Brushes No. 6 and No. 7, when closed, set up the time switch. While this instrument is intended to be used in conjunction with the author's timer (1), it could be made to set up any one of the motor-driven timers by turning on the current to the motor.

The exposure is made with the foot switch while the operator holds the cord in his left hand, as shown in Figure 2.

Fig. 2. Showing how the pull cord is used by the left hand of the operator, as he stands at the fluoroscope.

It is to be noted that while the brushes for the timer and filament controller are small, the ones that short the resistance should be large enough to carry about 50 amperes.

This instrument has been in steady use for over four years, needing no attention except an occasional drop of oil.

REFERENCE

TAFT, ROBERT B.: Time Switch of Unusual Design. RADIOLOGY, November, 1930, XV, 592.

# EDITORIAL

M. J. HUBENY, M.D. . . . . *Editor*
BENJAMIN H. ORNDOFF, M.D. . *Associate Editor*

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## THE RÔLE OF RADIOGRAPHY IN MATERNITY CARE

A distinctly modern phase of obstetric practice is the comprehensive care of the mother during pregnancy and after labor has been accomplished, especially the former. Obstetrics, it is being realized more and more, comprises much more than the mere delivery of the child. The prophylaxis of disease and of abnormal presentational complications has become a very important part of the duties of the obstetrician; and this prenatal care of pregnant women is now insisted upon in private practice as well as in the prenatal clinics for the poorer classes of women that have sprung up all over the country.

Our attention has been called recently to this subject by the illuminating report of the Maternity Center Association and the Statistical Bureau of the Metropolitan Life Insurance Company, of New York. The records presented by these organizations cover 4,726 women who were cared for during the eight years, 1922-1929, inclusive. Very striking results were obtained by this prenatal management, including a reduction of the maternal mortality to about a third of that obtaining among women not receiving the prenatal attention; a reduction of infant deaths in the first month of life of 32 per cent, as compared with the control group in the same metropolitan area, and a record of stillbirths 42 per cent lower than that occurring among women not receiving prenatal care.

No woman under this care died before delivery during the entire eight years; and only 11 mothers died from puerperal causes, a rate equivalent to but one puerperal death for every 430 pregnancies. The maternal mortality rate based on live births was 2.2 per 1,000, which compares favorably with the rate of 5.3 per 1,000 live births among white women in New York City. In the Bellevue-Yorkville district the mothers who did not have the care of the Maternity Center Association showed a maternal mortality rate of 6.2, or nearly three times as high as the rate for mothers who had that care.

Such results are very convincing, and amply emphasize the value of the care given the women.

It would be interesting to know just what part in this reduction of fetal and maternal morbidity and mortality was played by radiography of the pregnant women. No data are given on this subject in the records published by the investigating bodies. The very short period of exposure required to make roentgenograms of the pelvis and abdomen renders this valuable diagnostic aid absolutely safe; and when one recalls how much information of value may be obtained from these X-ray films, it becomes evident that radiography should hold a prominent place in the prenatal care of pregnant women.

Not only can deformities and contractures of the maternal pelvis be recognized early and appropriate treatment instituted, such as the induction of premature labor or an elective cesarean section, with or without

the test of labor, but fetal abnormalities of development and abnormal positions and presentations may also be noted early and the latter corrected in many instances. We firmly believe that every pregnant woman should be examined by the X-ray at intervals from the fifth month on, as a valuable aid to the obstetrician in noting the progress of the case. The fear that uvular or fetal death or deformity may be so produced may be discarded, for these accidents can occur only from prolonged irradiation in the very early weeks of gestation during the formative period of the embryo.

We believe that all that is necessary is to call the attention of these public welfare bodies to the value of a proposed innovation. Sufficient proof is now available to show that the judicious use of the X-ray in the diagnostic study of pregnancy has been productive of much good, and we can positively conclude that, consequently, the X-ray has become an important prophylactic measure and aid in obstetric diagnosis.

W. A. Newman Dorland, M.D.

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## REPORT OF CHAIRMAN OF COMMITTEE ON INSURANCE

*To the officers and members of the Radiological Society of North America, Sixteenth Annual Meeting, at Los Angeles, 1930:*

Your Committee on Insurance begs leave to present the following report:

During the past year several members of the Society have asked the Chairman what was known about certain insuring organizations and agencies, and, because of these inquiries, he has taken upon himself as a duty the investigation of some of these insurers, particularly those not well known to us.

After investigating one of these organizations which offers a rather attractive low premium rate, he secured the following information.

The — Company, of —, was incorporated several years ago, after certain of the regular malpractice insurance companies notified users of the Abrams Electronic Reactions methods that they must either discontinue using the "ERA" or have their malpractice insurance contract canceled. The — Company in question was organized on the mutual plan, a plan decried by men who know the malpractice insurance business and one which, it has been decided by courts of last resort, will render a member of such organization incompetent as a witness for and in a malpractice suit against any other member of the same organization (Hoover *vs.* McCormick, Kentucky case). The original board of directors of this Company consisted of three physicians, all "ERA" users, and two osteopaths. In about a year one of the physicians was displaced by an osteopath, whereupon the governing body was composed of three osteopaths and two physicians, and neither of these two latter were members of organized medicine. The Company's literature at that time stated that its organization was by, of, and for electronists, and a little later it made the same statement in regards to being by, of, and for osteopaths.

An abstract from a letter written by one of the officers of this insurance organization about three years ago reads in part: "You will be surprised to know how fast our company is becoming osteopathic in its membership." At that time one of the principal officers of that State's Osteopathic Association was on the directorate of this Company.

The insurance contract issued by this Company has contained several items to which serious exception can and should be taken, and with which serious fault can be found, but as these documents change from time to time some of these objections may have been eliminated.

Although the organization investigated

has been in business considerably over seven years, a recent financial report indicated that its assets amounted to less than $12,000, and the latest financial report shows its assets as less than $13,000.

Your Committee also desires to call the attention of members of the Radiological Society to a report of the "Bureau of Investigations" of the American Medical Association, published in the *Journal of the American Medical Association* for December 20, 1930, page 1931, and to suggest that all should read the last paragraph at *least three times,* and then refer to what your Committee on Insurance has repeatedly stated in regard to *mutual insurance companies.*

The Chairman of your Committee on Insurance receives from two to six letters every month relative to malpractice insurance, and answers from two to twenty questions regarding insurance in each letter. He has in preparation a paper covering the subject of malpractice insurance in a thorough manner, which it is hoped will be ready for publication some time within the next three or four months.

In conclusion, the Chairman desires to recommend that this Committee be continued and that this report be published in RADIOLOGY.

I. S. TROSTLER, M.D., *Chairman.*

A motion was made, seconded, and unanimously carried that the report be received and the recommendations concurred in.

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## HONORS IN OTHER SOCIETIES

Ulysses S. Kann, M.D., a member of the Society from Binghamton, New York, has been honored with the presidency of the Broome County (New York) Medical Society. Blinn A. Buell, M.D., is Vice-president, Henry D. Watson, M.D., is Secretary, and Charles Pope, M.D., is Treasurer.

Dr. Kann was likewise elected to the presidency of the Central New York Roentgen Ray Society, at the January meeting in Syracuse. Lucas S. Henry, M.D., a member of the Radiological Society of North America from Syracuse, was elected Vice-president, and Robert C. Hall, M.D., a member from Utica, was chosen Secretary and Treasurer of the Central New York Roengten Ray Society.

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## CANADIAN RADIOLOGISTS FOSTER EDUCATIONAL PROPAGANDA

At the recent joint meeting of the British and Canadian Medical Associations in Winnipeg the Radiological Section of the Canadian Medical Association decided to publish in the *Canadian Medical Association Journal* a series of papers the purpose of which is to present to the general profession an authoritative statement concerning the ever-enlarging field of X-ray and physiotherapy. In a Foreword in the January number of the *Canadian Medical Association Journal* the Editors refer to this program in the following statement: "We intend to publish a series of papers, designed for the general practitioner and the man working in the small hospital, dealing with the theory and practical applications of radiology and physiotherapy in their various aspects. These papers will be written by men expert in these particular fields and will be submitted for comment to specialists and others, in the hope that all sides of the subjects will be fully canvassed."

Dr. E. E. Shepley, of Saskatoon, Saskatchewan, has been appointed by the Radiological Section of the Canadian Medical Association to have general charge of this ambitious program, and he already has a large number of papers contributed and on

the way. We bespeak for Dr. Shepley the hearty co-operation of our American confrères when he appeals for help in carrying out this educational work.

L. J. CARTER, M.D.

## MINNESOTA RADIOLOGICAL SOCIETY

The midwinter meeting of the Minnesota Radiological Society was held February 14, 1931, at the Minnesota Club, St. Paul, Minnesota. The following program was presented:

Roundtable Discussion of Cases of Diseases of the Bones and of the Thorax. Conducted by R. G. ALLISON, M.D., Minneapolis.

Roundtable Discussion of Cases of Diseases of the Gall Bladder and of the Gastrointestinal Tract. Conducted by JOHN D. CAMP, M.D., Rochester.

Roentgenologic Changes Seen in Cases of Boeck's Sarcoid and Related Lesions. S. A. MORTON, M.D., Rochester.

A Correlation of the Various Factors Involved in the Classification of Chronic Arthritis. M. J. SHAPIRO, M.D., Minneapolis.

Pulmonary Metastases. EUGENE T. LEDDY, M.D., Rochester.

The Medical Histories of Cases of Carcinoma of the Stomach. JACOB SAGEL, M.D., Minneapolis.

## GOING TO PHILADELPHIA?

The American Medical Association holds its 1931 Session there June 8 to 12, inclusive.

The Pennsylvania Lines have furnished me with a diagram of a sleeping car on the train leaving Chicago at 12:30 P. M. and arriving at Philadelphia at 7:43 A. M. the morning of the first meeting of the Section on Radiology. All coming *via* Chicago may secure reservations by writing me. It is more pleasant to travel together.

I. S. TROSTLER, M.D.
812 Marshall Field Annex, Chicago.

# BOOK REVIEW

THE ORIGIN OF LYMPHOSARCOMATOSIS AND ITS RELATION TO OTHER FORMS OF LEUKOSIS IN WHITE MICE. By CARL KREBS, H. C. RASK-NIELSEN, and AAGE WAGNER. Acta Radiologica, Supplement X, Stockholm, 1930, pp. 53, with 15 plates.

This report of experiments and observations on 16,900 white mice is most interesting in that it appears to show that, in such animals, lymphosarcoma is the result of lowered resistance, and that such depression of resistance may be brought about by exposure to roentgen rays. Unfortunately, as an experimental report this communication cannot be regarded as a model. So many essential details have been omitted that, while the main results must be accepted as proved, many subsidiary points remain obscure, and the interpretations advanced cannot be analyzed satisfactorily. The doses given are not accurately described. In one place it is stated that to obtain "takes" in about 50 per cent of the animals the entire body of the animal had to be exposed to about 75 per cent of a lethal dose (minimum dose that will kill a mouse weighing from 15 to 20 grams within two weeks), and this was regarded as equal to about four-fifths of the human erythema dose through 5 mm. of aluminium. The quantity and quality of the rays are not specified. But when the dose was reduced to one-half the human erythema dose (about 60 per cent of the lethal dose), the percentage of "takes" di-

minished greatly. Further on the statement is made that "the smallest local irradiation given was of two erythema doses, applied in a single exposure on barely one-third of the animal's body at the hindmost part. Most of the doses were somewhat larger, however." That exposure of part or of the entire body of animals to roentgen rays should act to lower resistance to transplanted tumors is not surprising. However, these experiments do not furnish any clue to the factor or factors involved in such depression of resistance. Moreover, the possibility that such depression may have been partly due to factors other than irradiation has not been excluded.

Krebs, Rask-Nielsen, and Wagner never found bacteria in any of the tumors, thus confirming the work of Korteweg. Aside from the effect of roentgen irradiation in decreasing resistance and thus increasing the transplantability of lymphosarcoma, the most interesting results were that the majority of such transplanted tumors disappeared spontaneously, that it was possible to keep two strains alive for many generations, and that irradiation apparently facilitated the spontaneous occurrence of leukemic changes.

But perhaps the most interesting part of the report is the description of the lymphosarcomatous lesions found at necropsy. While such lesions may differ slightly from those occurring in human beings, one experienced in human lymphosarcoma must be impressed by the surprising analogy. Another noteworthy point is the tendency of the blood of affected animals to exhibit leukemic changes. As the total number of leukocytes increased the percentage of polymorphonuclear cells diminished and the percentage of lymphoblasts increased.

In attempting to explain why, in view of the atrophy of the lymphoid structures previously shown by Heineke, Ziegler, Fabricius-Moeller, Murphy, Morton, and others, exposure of their animals to roentgen rays should have given rise to leukemioid changes, Krebs, Rask-Nielsen, and Wagner favor the correlation theories of Ziegler and Naegeli, but they are not able to prove such a relationship and admit that similar disturbances may be produced by other means than roentgen rays.

A. U. DESJARDINS, M.D.

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## APPARATUS

**A New Model Radium Emanation Plant. Alexander J. Allen. Jour. Cancer Research, August, 1930, XIV, 461.**

The author describes a new model emanation plant in which a two-stage mercury diffusion pump is used in connection with a Megavac oil pump. The parts subject to strain are made of heavy pyrex glass. He feels that the apparatus is efficient, compact, and relatively inexpensive. The use of pyrex glass makes for ruggedness of construction.

JOHN R. CARTY, M.D.

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**Roentgen-ray Tubes, with Complete High Tension Protection up to 200 K.V. A. Bouwers. Strahlentherapie, 1930, XXXVIII, 157.**

The author, who has developed the Metalix tube, describes an equipment which is shockproof up to 200 K.V. and 8 milliamperes. A number of illustrations demonstrate the construction.

ERNST A. POHLE, M.D., Ph.D.

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**Nitrogen Peroxide from the Mechanical Rectifiers of a Deep X-ray Therapy Plant. Rollo K. Newman. Med. Jour. Australia, May 3, 1930, I, 581.**

In a room of cubic capacity, 36,790 liters (1,300 cubic feet), the total volume of nitrogen peroxide produced by running an X-ray machine at 200 K.V. and 30 ma. for 100 minutes was 2.13 liters, as measured by absorption in sodium hydrate.

The machine was of the two-unit type, employing the familiar and efficient rotating toroid system and spherical collectors.

J. G. STEPHENS, M.D.

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**The Half Value Layer Meter of Christen in a New Form. H. Th. Schreus. Strahlentherapie, 1930, XXXVII, 193.**

For practical purposes, a simple and inexpensive instrument to determine the quality factor in therapy is badly needed. The author has made an attempt at improving the half value layer measuring apparatus of Christen, and hopes that the manufacturers will soon offer a suitable model to the roentgenologist.

ERNST A. POHLE, M.D., Ph.D.

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**A Superficial Therapy Apparatus with Constant Output. W. Hondius Boldingh. Strahlentherapie, 1930, XXXVIII, 165.**

A movable apparatus is described, designed especially for skin therapy. It operates at 45 K.V. and has a stabilizer which maintains the transformer potential constant within 3 per cent. A time switch permits one to set the exposure time for various technics in r-units. Because of the constancy of the output, recalibration, according to the author, is necessary only at long intervals.

ERNST A. POHLE, M.D., Ph.D.

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**A New Measuring Device for Very Small Light Intensities. B. Rajewsky. Strahlentherapie, 1930, XXXIX, 194.**

A good photo-electric cell measures light energies as low as $10^{-7}$ erg per square centimeter per second. The author describes, in this article, an instrument designed similar to the counter of Geiger and Müller, for small intensities of roentgen rays, beta and gamma rays of radiation. By using an amplification system, the counting of the galvanometer deflections can be recorded automatically or over a loud speaker. Thus, the sensitivity is increased about 20,000 times over that of the photo-electric cell. For counts of twenty minutes, the error amounts to approximately plus or minus 2 per cent.

ERNST A. POHLE, M.D., Ph.D.

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**The Effect of Intensifying Screens in Relation to the Quality of the Radiations in Radiologic Technic. Vittorio Podestà. Rivista di Radiologia e Fisica Medica, May, 1930, II, 336.**

The author describes an experimental apparatus he has constructed to study photographic screens, with results as follows: The luminosity of the screen increases not only with the intensity of the rays but also with an

increase of the hardness of the rays (decrease of wave length), the latter because of the combination of effect in the film and intensifying screen. With an increase of voltage up to 85 kilovolts the increase of effect is regular, then it rises suddenly and evens off at about 120 kilovolts. Between these two voltages the maximum increase of photographic effect is obtained.

E. T. Leddy, M.D.

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**A Practical X-ray Serialograph. A. I. Arneson. Am. Jour. Surg., June, 1930, VIII, 1243.**

The author has constructed a tunnel 20 × 24 inches which will allow six separate exposures on one 10 × 12 film, each one 4 × 5 inches in size. This tunnel is suspended on an overhead trolley which runs on a one-inch gas pipe suspended from the ceiling. It is counterbalanced by an appropriate weight which runs in one of the nickel-plated standards of an old X-ray tube stand.

The advantages of this apparatus are that it can be pushed out of the way of the fluoroscope and yet is instantly available. It is easy by this method to make films of the duodenal cap in the upright position.

Howard P. Doub, M.D.

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**The Calibration of Grenz-ray Tubes. O. Gfrörer. Strahlentherapie, 1930, XXXVI, 786.**

The author has carried out a considerable number of measurements on low voltage apparatus and tubes with the Lindemann window. He concludes that fluctuations in the primary line are of much more influence to the emission of X-rays of long wave length than in the ordinary roentgen apparatus. For their elimination, it is necessary either to have automatic potential regulation or to check the output of the tube during the entire treatment. The voltmeter in the primary circuit does not give accurate readings of the secondary potential. All apparatus for use on low voltage tubes should be calibrated uniformly as to the tube potential. Numerous tables and curves illustrate the results of his investigations in detail.

Ernst A. Pohle, M.D., Ph.D.

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## APPENDIX (DIAGNOSIS)

**The Roentgen Diagnosis of Chronic Appendicitis. Henry J. Walton and Samuel Weinstein. Am. Jour. Roentgenol. and Rad. Ther., December, 1930, XXIV, 631.**

In a routine study of 1,000 consecutive gastro-intestinal examinations, there was roentgen evidence of a pathological appendix in 152 instances, or 15.2 per cent. In the series presented the diagnoses were based on: (1) direct findings; (2) indirect findings. Of the direct evidences, the visualized appendix, which empties slowly and is persistently tender to palpation, is the most common. Of the indirect evidences, the ileal and colonic stases are the most common. The diagnosis was confirmed either clinically or at operation in 133 cases, or 87.5 per cent. The incidence of appendicitis was noted to be greatest between the ages of 20 and 50 years.

The authors include a tabulation showing the incidence of the various types of gastro-intestinal pathology, one showing the distribution of the ages in the various groups as well as sex, while another shows the percentage of agreement between the roentgen and clinical findings.

J. E. Habbe, M.D.

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**Roentgenologic Observations of the Appendix. Werner Knothe. Röntgenpraxis, Dec. 1, 1930, II, 1057.**

The value of a roentgenologic examination for the diagnosis of diseases of the appendix is still debated. The filling or non-filling of the appendix after a barium meal has been used as a diagnostic sign. The author uses a barium enema and finds that he can, by this method, demonstrate the appendix as often as when the barium meal is used. A normal appendix is usually demonstrable, and only very few roentgenologists believe, at the present time, that visualization of the appen-

dix indicates pathology. Peristaltic waves can be observed occasionally, and a sphincter-like contraction at the base may often be seen. Failure of roentgenologic demonstration in combination with localized tenderness indicates a pathological process. Several cases, with reproductions of films, illustrate the author's method.

H. W. HEFKE, M.D.

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**The Pathological Appendix. Albert F. R. Andresen. Med. Jour. and Record, Aug. 20, 1930, CXXXII, 178.**

What is meant by the term "pathological appendix" as returned by the roentgenologist, and what shall be done for a patient with such a diagnosis? Such a conclusion from X-ray evidence is based on a definite group of findings, including filling of the appendix with barium, failure to expel this in normal manner, with deformity and abnormal functioning of cecum, sometimes with reflex pylorospasm. Such findings indicate a condition usually known as "chronic appendicitis," which is itself usually a part of a general gastro-intestinal infection. Operation is indicated only in cases showing persistent symptoms due to complications. Eradication of all infective foci, of which the appendix may be one, with proper hygienic and dietetic care both pre-operative and post-operative, is essential.

W. W. WATKINS, M.D.

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**The Roentgen Symptoms of Post-appendicitic Abscesses. Rudolf Pohl. Fortschr. a. d. Geb. d. Röntgenstr., July, 1930, XLII, 19.**

Fluoroscopic and radiographic observations during and after opaque clysma, eventually aided by air insufflation, and also following expulsion is the technic described by the author. Careful roentgen exploration never aggravates. In cases offering diagnostic difficulties valuable information may be obtained, though a definite diagnosis usually may be made only by correlation of all anamnestic clinical and roentgenologic data.

The following classification is given:

(1) Perityphlitic abscess—
   *(a)* completely encapsulated,
   *(b)* communicating with cecum and eventually extending into adjacent tissues.

(2) Abscesses originating from an appendicitis but located distant to the cecum—
   *(a)* pelvic abscess,
   *(b)* subphrenic abscess (not discussed),
   *(c)* intraperitoneal abscess somewhere else in the abdomen.

A number of good illustrations elucidate the author's points—filling defects, displacements, irritability of bowel, abscess cavities filled or lined with contrast medium, stenoses, etc. For differential diagnosis, tuberculosis, fungus infections, and invaginations must be considered, besides extra-intestinal pathology, such as parametritis, abdominal metastases, ovarian tumors, etc.

This is an interesting paper, and well worth reading.

HANS A. JARRE, M.D.

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## BLOOD CHANGES

**Researches on the Blood of Radiologists. Jacques Lavedan. Radiophysiologie et Radiotherapie, 1930, Vol. I, Fasc. IV, 477.**

This paper is based upon the results of repeated blood examinations in a large number of persons of both sexes, engaged in X-ray and radium work. These comprise radiologists, technicians, and the general personnel of the Radium Institute of the University of Paris. The conditions of work as regards protection, hours of work, and holidays are given in detail, and these appear to be in conformity with accepted international standards. Only in the case of workers with the radon extraction apparatus was the possibility of considerable exposure present, although it was found that in some cases in which theoretically adequate protection had been provided, small defects were present which were capable of rectification. It was found that there is a very great variation in the effect of exposure to radiation on the blood in different individuals.

In some cases, definite changes were found after only a few weeks of exposure, while in others, working under identical conditions, no changes were found even after years of exposure. The commonest modification found in the blood picture is an increase in the mononucleated cells, either relative, with a diminished total leukocyte count, or absolute, with a normal or increased total count. (Under "mononucleated cells" are included all varieties of lymphocytes, mononuclears, and transitional cells.) In the most marked cases there may be a true inversion of the ratio of mononuclear to polymorphonuclear cells. In the opinion of the author this change cannot be considered as of grave importance. There is no evidence that the resistance to infection is lowered, nor can it be regarded as a pre-leukemic condition. It was found that a holiday of a few months or even weeks resulted in a return of the blood count to normal, or, at any rate, in a marked amelioration of the condition.

The author believes that the occurrence of these changes in the blood of X-ray and radium workers is always to be regarded as an indication that the protection is insufficient, even when the latter appears to be theoretically perfect, and that the blood counts can always be restored to normal by increasing the protection. Great importance is attached to the maintenance of a strict discipline in X-ray and Radium Departments, in order to insure that the rules of personal protection shall not be relaxed under any pretext whatever. However good the protection, it is urged that all X-ray and radium workers be submitted to blood examinations three or four times a year, since the blood, being the most radiosensitive tissue in the body, can give the earliest indication of injury from radiation.

WALTER M. LEVITT, M.B., D.M.R.E.

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**The Behavior of the Blood Phagocytes in Irradiated Guinea Pigs. Ludwig Pincussen. Strahlentherapie, 1930, XXXIX, 103.**

The phagocytosis in the blood of guinea pigs before and after exposure of the animals to a quartz mercury vapor lamp and a Vitalux lamp was studied by the author. From the ear, 0.1 c.c. of blood was taken, blown into a paraffinized test tube containing 0.5 c.c. of a solution which was made up by dissolving 0.5 gram NaCl and 0.4 sodium citrate in 100 c.c. of water. This was shaken well and then hydro-kollag 300 J. D. Riedel-E. de Haën added. The latter had been diluted with water twenty times, centrifuged ten minutes at 2,000 revolutions, and the resulting suspension was used for the experiments. Two drops of the blood suspension were added to the centrifuged solution, stirred with a glass rod, and then placed for one hour in a water bath at 37 degrees centigrade. After that, microscopic slides were made and stained with the Pappenheim method. It appeared that the phagocytic action of the leukocytes, measured by the percentage of phagocyting cells, was not increased by ultra-violet nor by visible light. An increase could be observed only following a rise of the temperature from 37 to about 39½ degrees centigrade.

ERNST A. POHLE, M.D., Ph.D.

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**Fluctuations of the Blood Pressure Following X-ray Treatment and Their Clinical Significance. Hans Pausdorf and W. Nell. Strahlentherapie, 1930, XXXVIII, 40.**

Fluctuations in the blood pressure observed immediately following exposure to roentgen rays must be separated from those appearing 24 or 48 hours later. The blood pressure changes immediately after irradiation are irregular, while those manifesting themselves from one to two days after the treatment show definite cycles. Following an extensive treatment they may re-appear even between the twenty-fifth to the thirty-fifth day or between the fiftieth to the seventieth day. The lowering of the blood pressure is not due to the effect of roentgen rays upon the suprarenals but can be explained by a systemic reaction caused by the decay products formed during and following the exposure. They produce an increased irritability of the vasodilating nerves. The degree of the blood pressure

changes may be used as a factor in determining the prognosis and the proper interval between treatments.

ERNST A. POHLE, M.D., Ph.D.

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**Further Studies of the Effect of Radiation on Blood Cholesterol in Malignant Disease. Walter L. Mattick and Melvin C. Reinhard. Jour. Cancer Research, August, 1930, XIV, 426.**

The authors determined the cholesterol content of the blood of twenty-five carcinoma patients, who had received high voltage therapy, at one-half hour intervals, beginning from thirty minutes before treatment to three hours afterwards. The Sackett modification of Bloor's method for the cholesterol content of the whole blood was employed. No characteristic change in the cholesterol level of the whole blood was noted in the three-hour period.

JOHN R. CARTY, M.D.

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**Comparative Studies of Blood Injuries Following Roentgen Irradiation with the Old Treatment Technic and the Ray-proof Metalix Tubes. Walter Fürst. Strahlentherapie, 1930, XXXVII, 659.**

During the treatment of patients by the open tubestand method, a considerable amount of indirect radiation reached the body. The author has made an attempt to measure this undesirable amount of additional radiation by comparing the old technic with the modern procedure using Metalix tubes. The total radiation received by the patient with the two methods is in the ratio of seven to five. He believes that the systemic effect as well as the injuries to the blood are much less if the patient is treated by the modern method.

ERNST A. POHLE, M.D., Ph.D.

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## BONE (DIAGNOSIS)

**Bone Changes in a Case of Chronic Empyema. T. Dale. Acta Radiologica, 1930, XI, Fasc. 5, No. 63, p. 537.**

The author reports in detail a case displaying the familiar bone changes seen in chronic pulmonary diseases, in which the long bones revealed periosteal thickening and widening of the cortex. After rib resection and drainage the patient recovered from empyema. Examination by roentgenograms of the bones of the arms, legs, hands, and feet, a year and a half later, showed them to be practically normal. The author believes that these bone changes are due to a combination of toxemia and endocrine disturbances.

ALAN L. HART, M.D.

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**Contributions to the Pathologic Osteology: (A) Unilateral Patella Partita; (B) Joint Formation in the Body of the First Rib. A. Pickhan. Röntgenpraxis, Nov. 1, 1930, II, 969.**

*(A)* The fact that the patella partita may be found on only one side is not definitely known. If it is bilateral there is usually no difficulty in the differential diagnosis from a fracture. Three cases of this congenital anomaly are described by the author, who states that it may be differentiated from fractures by the smooth edges of the dividing line, and by the absence of any callus.

*(B)* The formation of a joint in the body of the first rib is a very rare anomaly. Such a case is described and some reproductions are shown.

H. W. HEFKE, M.D.

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**The Symphysis Pubis in the Roentgen Examination of the Sacro-iliac Joint. W. Edward Chamberlain. Am. Jour. Roentgenol. and Rad. Ther., December, 1930, XXIV, 621.**

The author demonstrates that the ordinary roentgen examination of the sacro-iliac region does not demonstrate the presence of sacro-iliac relaxations or subluxations. The technic used by the author consists of five films—a stereoscopic pair in posterior projection, with the symphysis pubis and the entire pelvic brim in the field; a lateral projection centered at the lumbosacral junction, and two anterior projections, the patient standing, one with the patient's entire weight borne on the right leg, and the other with his weight on the left leg.

These latter films, made with the weight bearing on one leg only, serve to demonstrate radiographically a difference in elevation of the pubis, the upward movement of this bone serving as the long arm of a kymographic recorder to demonstrate an abnormal degree of rotatory motion in the sacro-iliac joint, hence making possible the diagnosis of "sacro-iliac relaxation." In the author's series of cases, the side of acute back symptoms is almost always the same side as that showing the high pubis. With this technic, normal individuals were first studied and normal movements were measured at the symphysis pubis in the male and non-pregnant female. The article is well illustrated.

J. E. Habbe, M.D.

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**A Contribution to the Etiology of the So-called Talalgia. J. Odessky. Röntgenpraxis, Dec. 1, 1930, II, 1092.**

Certain bone changes, which may be demonstrated by a roentgenologic examination, are the cause for the so-called talalgias. These changes consist of the formation of a spur on the lower surface of the heel and proliferative changes of the upper and posterior part of the os calcis. This latter process is an osteoperiostitis in the region of the insertion of the tendon of Achilles. Any infection, and not gonorrhea alone, may be the etiological factor. It cannot be said definitely at the present time whether or not cholera may be considered as a causative factor. The pains which accompany this are usually due to the inflammation of the bursa and the osteoperiostitis on the upper and posterior portions of the os calcis. Surgical removal of the spur does not always relieve the pain.

H. W. Hefke, M.D.

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## BONE (THERAPY)

**Fractures of the Os Calcis. Giuseppe Rotolo. Clinica Chirurgica, 1930, VI, No. 5, p. 483.**

This article, which is a statistical study of one hundred cases and a clinical review of fifteen cases, is primarily concerned with a discussion of the two types of treatment, namely, operation and manipulation and immobilization. Fractures of the os calcis represent 1.49 per cent of all fractures and 3.95 per cent of fractures involving bones of the foot. The author is an advocate of the bloodless method, for which he shows after-results at least not worse than those obtained by operative procedures. The patient is allowed to walk on the fifth day and physiotherapy is started on the fortieth day. Operation is advised in the avulsion fractures of the posterior tuberosity and arthrodesis in bad sequelæ. Ankylosis occurs spontaneously if the articular surfaces of both the os calcis and astragalus are involved.

The os calcis is crossed by four systems of trabeculæ. Between the anterior apophysary and thalamic, both of which run vertically, there is a sort of medullary cavity which constitutes a weak point in crushing fractures. The plantar system is horizontal and the system of Achilles runs in the direction of the tendo achillis.

Fractures of the os calcis are classified by Destot and Morel into four types: Fractures of the body of first, second, or third degree, varying from a subthalamic fissure to the bursting of the whole bone; fractures of the greater apophysis; fractures of the lesser apophysis, and fractures of the posterior tuberosity. The great majority of fractures of the os calcis result from a crushing mechanism. The lesion starts with a deepening of the thalamus where the various systems of trabeculæ converge to form a solid wall; crushing of the body occurs next, followed by irradiation of lines of fracture to the posterior tuberosity. These fractures may be associated with fractures of the inferior third of the bones of the leg or with the other bones of the tarsus.

The X-ray examination is made in the lateral and antero-posterior directions. Sometimes atypical positions are chosen in order to direct the central ray parallel to the planes of fracture. Stereoscopic views are occasionally made. It is of interest to note that ten cases of fractures of the body showed enlargement of the transverse diameter in the antero-posterior films. The X-ray examination is espe-

cially important because it shows the position of the fragments and is the only guide to the proper manipulation of the fracture previous to immobilization.

The author's personal method of treatment is described. The article is well illustrated and a good bibliography is appended.

V. WITTING, M.D.

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**The Effect of Irradiated Ergosterol on the Healing of Experimentally Produced Fractures in Animals. Howard A. Swart. Jour. Bone and Joint Surg., April, 1930, XII, 360.**

Leg fractures were studied in forty rabbits and twenty rats, half on a standard diet, and half receiving in addition small doses of viosterol. Roentgenograms taken at eight-day intervals, and tissue from animals killed at intervals of five days failed to show significant differences between the treated animals and the controls.

PAUL C. HODGES, M.D.

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**The Relationship between the Hypophysis and the Formation of Callus in Bone: An Experimental Study. A. Spinelli and Ferdinando Talia. Archivio di Radiologia, July-October, 1930, VI, 748.**

In a series of experiments carried out on dogs with fractured limbs in which the hypophysis was irradiated, the authors found the following: *(a)* after irradiation of the hypophysis with stimulating doses (1) precocious formation of bony callus, (2) more rapid evolution of the callus, and (3) greater osteoblastic formation and greater periosteal reaction; *(b)* after inhibiting doses (1) delayed formation of callus, (2) delayed development.

E. T. LEDDY, M.D.

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**Recovery from Fracture of the Neck of the Femur in a Nonagenarian. Roscoe C. Webb. Ann. Surg., December, 1930, XCII, 1112.**

Roentgenograms of a ninety-three-year-old woman, taken on the day of injury, showing an intracapsular fracture of the neck of the left femur, with the distal fragment displaced upward about one inch and rotated outward, and then again four months later, taken in abduction, showing the fracture to be in perfect position, with no absorption of the femoral neck, are unusually convincing. The author used the artificial impaction method of Cotton, and followed with the Whitman abduction and a plaster cast for three months. Besides general nursing care the patient was made to lie on her abdomen for one hour, three times daily. The fracture was set four days after the injury. An excellent portable roentgenogram was obtained of the fracture while the patient was under general anesthesia, and before the plaster cast was applied.

F. B. MANDEVILLE, M.D.

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## BONE DISEASES (DIAGNOSIS)

**Kienböck's Disease of the Semilunar Bone. N. Porro. Archivio di Radiologia, July-October, 1930, VI, 690.**

The author reports and discusses, from a clinical and roentgenologic point of view, six cases of Kienböck's disease.

E. T. LEDDY, M.D.

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**The Roentgenological Differentiation of Benign and Malignant Diseases of the Bones. Robert Kienböck. Med. Klinik, Nov. 7, 1930, XXVI, 1655.**

Between the terms "benign" and "malignant" are many grades, and the exact differentiation of them is hard to make. Only the osteomas (cartilaginous exostoses) are absolutely benign; only the blastomas (carcinomas and sarcomas) are absolutely malignant. Even in these groups, some are more benign than others (metastases of a thyroid carcinoma, adenocarcinoma). The chondromas of the skeleton should be called "semi-malignant" —they might stay benign or might degenerate into chondrosarcomas. In this group should be named also the lymphosarcomas, myelomas, xanthomas, and lipoidomas. Giant-cell tumors and the generalized osteitis fibrosa cystica are "pseudo-malignant." They are only bone dystrophies and not real tumors—both stay be-

nign and do not develop into sarcomas. Paget's disease is somewhat different; in from 3 to 5 per cent of all cases, a sarcoma develops, although the disease *per se* is benign and chronic. Some purely infectious bone diseases can be called malignant, as they progress rapidly and lead to the death of the individual. No single clinical symptom which is pathognomonic is known. The roentgen signs also are not so definite that one alone proves or disproves the benign or malignant character. Chondromas, bone cysts, and carcinomatous metastases might give very similar pictures. The differential diagnosis between sarcomas and hematomas, tuberculosis, syphilis, and purulent osteomyelitis is sometimes very difficult. It is not possible to give an easy guide for making a diagnosis and differentiating benign from malignant lesions. The entire roentgenologic picture, sometimes only with the help of the clinical findings, leads to a correct diagnosis.

H. W. Hefke, M.D.

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**A Case of Generalized Osteitis Deformans (Paget), with Secondary Malignant Degeneration. Viggo Genner and Harald Boas. Acta Radiologica, 1930, XI, Fasc. 4, No. 62, p. 398.**

The authors describe a case of generalized osteitis deformans which developed a sarcoma of the scapula. The possible etiologies of Paget's disease are discussed. The pathology and roentgen findings of osteitis deformans are described in detail.

M. J. Geyman, M.D.

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**Osteochondritis Dissecans, Considered from the X-ray Standpoint. Gösta Jansson. Acta Radiologica, 1930, XI, Fasc. 1, No. 59, p. 33.**

Perthes' disease, Osgood-Schlatter's, Köhler's, Kienböck's, etc., have now been collected under one head as epiphyseal necroses.

In 1888, König announced his theory of spontaneous, aseptic necrosis in epiphyses, with the separation of necrotic bone as the result; he believed that trauma was only a contributory factor added to an unknown basic cause. Other students of this disease held that injury was the sole etiologic factor. This view has not been substantiated by experimental research.

In 1922, Lieck identified osteochondritis dissecans with the other epiphyseal necroses. He believed the underlying cause was of an endocrine nature.

The author upholds Axhausen's theory that aseptic necrosis in an epiphysis results from an embolus and the consequent infarct. Localized bone necrosis, produced experimentally by an electric current, shows a pathologic picture resembling that of osteochondritis dissecans as well as Perthes' and Köhler's diseases. While the infarct is developing and before there are any loose fragments of bone in the joint, the patient has only mild rheumatic pain; but after the separation of the pieces of necrotic bone and cartilage, the patient develops the typical symptoms of sudden pain and fixation of the joint. Jansson believes that the lesions in the epiphyses are analogous to the anemic infarcts seen at autopsy in various organs. He states that the cartilage is not involved in the necrosis but is undermined by the necrotic process in the bone itself. Slight trauma may cause the affected area of bone to be torn off, carrying a section of normal cartilage with it. He has studied a large number of cases of traumatic "joint mice" and has never found them to contain normal joint cartilage. He believes they probably result from trauma to an arthritic joint, and consist of fractured fragments of pathologically changed bone. Films of the joint in these cases have not showed defects in the condyles of the femurs.

Osteochondritis dissecans usually occurs in young adults, although cases are seen in older persons. It is commoner in men than in women, may be bilateral, and is most often found in the knee and in the medial condyle of the femur. As a rule, the patient gives no history of any significant injury preceding the onset of symptoms. Roentgenograms are the most important method of diagnosis. It is essential that both antero-posterior and lateral films of the affected joint be made. The typical case presents on the films a large or

small area of bone destruction near the articular surface of the medial condyle of the femur. This defect may appear empty or may contain small pieces of bone. It does not protrude beyond the articular surface. After the fragments have separated and fallen into the joint, one can usually see an irregular defect in the condyle, as well as the free bone fragments in the joint. Small "joint mice" may be connected by a thin strand, with the defect in the femur.

The author reports ten cases of osteochondritis dissecans in persons ranging from 21 to 46 years of age. Two of the patients were women; eight were men. He gives the clinical history and operative findings, in addition to the X-ray evidence. The roentgenograms of the joints are supplemented by films of the fragments of bone removed from the joints at operation. These "joint mice" are seen to consist of both bone and cartilage; the bone sometimes shows areas of rarefaction and bone destruction. In some instances these free bodies consisted of cartilage in which were embedded small fragments of bone. Some of them had been fractured, and a few had one surface entirely covered with cartilage. He emphasizes the apparent impossibility of so much bone destruction occurring in the short time that generally elapses between the trivial injury, often recalled by the patient, and the onset of the symptoms of osteochondritis dissecans. It is his belief that this strongly destructive character of osteochondritis dissecans speaks for an embolic origin rather than a traumatic one, and he concludes that it forms an etiologically distinct group of joint diseases.

A. L. HART, M.D.

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**Two Cases of Unusual Localization of a Chronic Bone Abscess (Brodie). A. Mariupolsky. Röntgenpraxis, Nov. 1, 1930, II, 996.**

The clinical and radiological appearances of chronic bone abscesses are well known. Of the nine cases observed by the author, two were found in the patella. This localization has not heretofore been described. The history and the clinical and surgical findings are described in detail. Clinically, the knee joints were affected secondarily. The localization of these abscesses is usually around the epiphyses, but the two cases reported by the author and those published by other authors prove that the small bones may also be attacked.

H. W. HEFKE, M.D.

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**Idiopathic Osteopsathyrose. Leon Prussak and Natan Mesz. Acta Radiologica, 1930, XI, Fasc. 2, No. 60, p. 175.**

The authors detail the history of the knowledge of this disease, starting a century ago with Lobstein, who was the first to describe the anatomical bone changes. Not until 1891 was the blue coloration of the sclera noted. At present the classical picture of this disease consists of (1) fragility of bones; (2) slate blue sclera, and (3) disturbances of hearing. The auditory symptoms are usually present in adults, but absent in children. There are abortive cases exhibiting only one of the cardinal symptoms. This disease often has a heredofamilial distribution, although it may skip a generation and often does not affect all the members of a family. It does, however, occur sporadically now and then.

The most prominent symptom is the fragility of the bones. The osseous changes, as seen on the roentgenogram, are: (1) thinning of the cortex; (2) widening of the marrow cavity; (3) calcium deficiency; (4) multiple fractures. The periosteum and epiphyses are not involved. Any bone may be affected, but the long bones, especially of the legs, suffer most frequently. The fragility of bones may reach such a degree that even a vigorous muscle contraction will produce a fracture. Some cases, with over a hundred fractures have been reported. These fractures commonly occur in infancy and early childhood, reach their height of incidence during adolescence, and are rare after 26 years of age. They often cause so little pain that the patient is unaware of them and their discovery is first made by the X-ray examination. The callus which forms is well-developed but so poor in calcium that it throws a faint shadow on the films of the bones. The healing proceeds with moderate rapidity and is often so com-

plete that it is difficult to recognize the sites of earlier fractures on roentgenograms. Most of the fractures occur spontaneously without serious injury, or even while lying in bed. Great deformity of the limbs may result from numerous fractures.

The blue color of the sclera is thought to be due to an unusual transparency of this coat of the eye-ball, permitting the choroid pigment to show through. The skull shows protuberances in the forehead, occiput, and temples. These cranial deformities plus relaxation of the structures in the middle ear, plus otosclerosis, are considered as the probable cause of the disturbances in hearing that develop during adolescence. Other inconstant symptoms are as follows: changes in electrical reactions of the muscles, thinning of the hair, trophic changes and pigment deposits in the skin, abnormal secondary sexual characteristics, corpulence, and hypothyroidism.

In the differential diagnosis there must be considered: (1) osteomalacia; (2) fractures in rachitic children; (3) osteogenesis imperfecta. The X-ray examination will not distinguish between idiopathic osteopsathyrose and osteomalacia; clinical data are necessary. Rachitic children never show so many fractures as patients with idiopathic osteopsathyrose; furthermore, the rachitic fracture develops a strong callus rich in calcium, and the cortex in rickets is thickened and the epiphyses involved in contra-distinction to idiopathic osteopsathyrose. Osteogenesis imperfecta presents a pathological picture very similar to that of idiopathic osteopsathyrose, but runs a different clinical course. Children afflicted with the former disease are often born with fractures or sustain fractures in the first days of life, are always very delicate, and usually die in very early childhood; whereas, patients with idiopathic osteopsathyrose are well-built physically and have a good prognosis as to life, while their fractures come on in later childhood and reach their peak during adolescence. Possibly these two diseases represent the same entity, occurring in different periods of life.

Nothing definite is known of the pathogenesis of idiopathic osteopsathyrose. Some students believe it is a developmental defect; others that it is of endocrine origin, and still others that it is based on chemical changes in the composition of the bones.

The diagnosis is easy in cases presenting two of the cardinal symptoms, but is likely to be very difficult when only the bone fragility occurs. The authors report three cases as follows, two of which were typical, and the third showed multiple fractures and a chronic, organic disease of the brain:

(1) This case, a girl of 12 years, exhibited multiple fractures, blue sclera, heredofamilial tendency, corpulence, and precocious puberty.

(2) This case, a boy of 2½ years, showed the characteristic personal symptoms, but no heredofamilial tendency.

(3) This case, a boy of 8 years, failed to present the heredofamilial traits, but presented typical bone changes. He had epileptiform attacks and pyramidal symptoms, and was an imbecile as well.

The article is illustrated by a number of plates showing the physical state of the patients, and bone injuries and deformities.

A. L. HART, M.D.

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**Melorheostosis (Léri) and the Generalized Osteitis Condensans or Osteopoikilia (Albers-Schönberg). A. Kahlstorf. Röntgenpraxis, August 15, 1930, II, 721.**

A new case of melorheostosis is described by the author. This rare bone affection is a disease which attacks the bone of only one extremity in a segment-like band of osteosclerotic bone, and which, contrary to other bone changes, is not generalized nor present in separated foci. It appears that the bony sclerosis begins during the time of bone-growth in childhood or adolescence. The clinical symptoms, which usually appear late, are slight compared with the massive bone changes. In the author's case, the band-like lesion suggests a congenital anomaly, nothing definite being known about the etiology or pathogenesis. The ten cases of this disease so far described in the literature are reviewed and a bibliography is given.

Another rare bone disease is the generalized

osteitis condensans (Albers-Schönberg), also called osteopoikilia. The twelve cases heretofore described in the literature are briefly reviewed, and another case is added. Multiple, small, dense areas were found scattered through the extremities. One has to do apparently with an anomaly of ossification which is clinically of no importance and leads to no symptoms.

H. W. HEFKE, M.D.

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## BONE TUMORS (DIAGNOSIS)

**A Contribution to Chondromatosis of the Joints. Hofmann. Röntgenpraxis, Sept. 15, 1930, II, 842.**

Chondromatosis of a joint is usually limited to one joint alone. In the case reported by the author, the knee joint and elbow joint were involved. Traumatic influences are not responsible for this disease, but it may be caused by a development of these tumors from embryonal cells. Differential diagnostic difficulties do not often exist. However, arthritic changes may be associated with this disease.

H. W. HEFKE, M.D.

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**Pathological Fractures in Primary Bone Tumors of the Extremities. Bradley L. Coley and George S. Sharp. Am. Jour. Surg., August, 1930, IX, 251.**

Pathological fracture occurred as a complication in 22.7 per cent of a series of 185 primary bone tumors of the extremities. This occurred in 25.7 per cent of endothelial myeloma, in 25 per cent of giant-cell tumor, and in 21.3 per cent of osteogenic sarcoma.

While it was found that three-fourths of the tumors occurred in the lower extremities, pathological fractures are most common in the upper extremities, and the upper end of the humerus was the region of greatest susceptibility to fracture. Fracture was the initial symptom in one-fifth of all the cases, but it did not occur as an initial symptom in any of the endothelial myeloma cases.

The life expectancy of a patient with osteogenic sarcoma in whom a pathological fracture has occurred is shortened 60 per cent. All the patients with fracture through giant-cell tumor are living, one to eight years. Fracture was followed by union in 3 of the 7 cases of endothelial myeloma; in 7 of the 9 cases of giant-cell tumor, and in none of the 26 cases of osteogenic sarcoma.

Pathological fracture may be postponed, or even prevented entirely, by early and continuous support. The failure to immobilize a limb in which a pathological fracture has already occurred may predispose to early dissemination.

HOWARD P. DOUB, M.D.

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## CANCER (DIAGNOSIS)

**The Clinical Manifestations of Primary Bronchial Carcinoma. Elmer H. Funk. Jour. Am. Med. Assn., Dec. 20, 1930, XCV, 1879.**

This essay is based on an analysis of the clinical features presented by sixty-one patients with primary carcinoma of the bronchus, in whom the diagnosis was verified by histologic examination of tissue removed. The predominance among men and the incidence after the age of 35, particularly from 35 to 45, are factors of significance in diagnosis. The author quotes Weller that the type of carcinoma occurring in the hilum, comprising perhaps 90 per cent of all cases, is practically always bronchiogenic. The clinical features vary greatly, depending on the following factors: (1) the location of the neoplasm and the rapidity of its growth; (2) the degree of bronchial obstruction produced; (3) the presence of secondary infection and suppuration; (4) the pressure on adjacent structures; (5) the occurrence of pleural involvement, which is not infrequently associated with effusion, and (6) the influence of local and general metastasis. The relative frequency of the local symptoms was as follows: cough, 88 per cent; expectoration, 67 per cent; pain, 72 per cent; hemoptysis, 45 per cent; dyspnea, 50 per cent. The general symptoms of weakness and loss of weight follow, as a rule, the occurrence of the local symptoms, and were sufficiently evident to be

noted as a part of the present illness by the patient in 80 per cent of the cases.

In extra-thoracic metastases any organ may be involved. An early and significant finding, clinically, is metastasis to the supraclavicular nodes. In most instances extra-thoracic metastases were late phenomena. Fried and Buckley found central nervous-system metastases in fifteen of thirty-seven patients with bronchiogenic cancer. The primary tumor may be overlooked. The roentgenologic evidence may be most valuable in determining the presence and location of the tumor, especially when the hilar mass is sufficiently large and not obscured by the many secondary pathologic changes which occur in the lung and pleura. When these are present the roentgen picture may resemble numerous other pulmonary lesions.

Bronchoscopic observation represents the most recent and important advance in thoracic diagnosis, and is the only method by which an early diagnosis of bronchial newgrowth can be made, with reasonable certainty in the vast majority of patients. Certain conditions which cause confusion, but which a complete study should exclude in the majority of cases, are: tuberculosis; bronchial obstruction from other causes; pulmonary abscess; syphilis; pneumoconiosis, and pleurisy. Generally, the prognosis is bad, and a fatal outcome occurs within a relatively short period of time.

C. G. SUTHERLAND, M.D.

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**Diagnosis and Treatment of Early Cancer of the Breast. William L. Hearst. Jour. Iowa St. Med. Soc., September, 1930, XX, 400.**

The early recognition of cancer of the breast is very important, for not until a reasonably accurate diagnosis is made will an operation for its removal be permitted, and the earlier the operation the more hope of cure. At present, operation is the only method whereby we may hope for a complete cure. The great majority of breast tumors are malignant (85 per cent or more according to Mayo), and a fair proportion of the benign ones develop malignancy. All tumors not positively proven to be benign should be removed, and the removal should be *in toto*, with all infected and enlarged glands in the axillary space or any other place. After such an operation the breast should be radiated thoroughly and for a sufficient length of time. In more advanced cases the pectoralis major and fascia and muscle of the pectoralis minor should be removed, with the glands in all the spaces and supraclavicular area, extending to the chest wall. X-ray treatments should then be given as soon as possible and continued until all suspicion of recurrence is past.

W. W. WATKINS, M.D.

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**A Case of Carcinoma of the Thymus, with Extensive Metastases, in a New-born Child. George V. Bedford. Canadian Med. Assn. Jour., August, 1930, XXIII, 197.**

This case presents a number of features which are unique, *viz.*, the combination of primary carcinoma of the thymus, with metastases in the liver, lungs, bones, and skin. Primary carcinoma of the thymus is rare, and metastases in the skin of an infant are exceedingly rare.

The child at birth was covered with a generalized eruption which was partly pustular and partly hemorrhagic.

X-ray examination four days after birth showed enlarged thymus, infiltrated shadows in the lungs, spontaneous fracture of four ribs, and rarefaction areas in both femora and both tibiæ and fibulæ.

Wassermann reaction was negative on two tests. Sections of tissue examined in the Department of Dermatology and Syphilology of the Mayo Clinic proved to be carcinoma of the thymus, with metastases in bones, lungs, liver, and skin.

L. J. CARTER, M.D.

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**The Diagnosis and Treatment of Cancer of the Stomach. Penn Riddle. Texas St. Jour. Med., September, 1930, XXVI, 348.**

Of the deaths from cancer, 25 per cent are due to cancer of the stomach. The outstanding progress in the early diagnosis of cancer of the stomach has been due to the more extensive use of the X-ray, very little progress

having been made in the early recognition of the disease from the interpretation of clinical symptoms. Of the patients coming to the Mayo Clinic with cancer of the stomach, one-half are operated upon, and one out of four has an operable lesion. According to Balfour, the X-ray will correctly disclose from 96 to 98 per cent of organic gastric lesions, and three out of four of these are malignant. The problem is to train people to come early in the development of gastric symptoms. The treatment at present is entirely surgical. The X-ray is of little value in determining operability, and this can be learned only by exploration.

W. W. WATKINS, M.D.

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**Primary Carcinoma of the Ureter. Henry J. Lindner, Rigney D'Aunoy, and R. J. Mailhes. Med. Jour. and Record, Sept. 17, 1930, CXXXII, 290.**

A case of primary carcinoma of the ureter is reported, being the forty-eighth case on record and the eighth diagnosed before operation, with a *résumé* of the salient clinical and pathological features of all recorded cases. No etiology can be ascribed, concurrent calculus being present in only eight cases. Hematuria, pain, and renal and ureteral dilatation are most frequently encountered. Diagnosis is difficult, but is greatly facilitated by a careful history, the use of cystoscopy, pyelography, and pyeloureterography. Radical operation is the treatment.

W. W. WATKINS, M.D.

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**The Diagnosis of Cancer. Francis Carter Wood. Jour. Am. Med. Assn., Oct. 18, 1930, XCV, 1141.**

While it is perfectly possible to have the lay public absorb a certain amount of information concerning the symptoms of cancer, after such absorption has taken place and the desired reaction has occurred, the profession is not in a position, speaking generally, to render efficient service to those who apply for it. The medical profession, as a whole, is not yet prepared to accurately diagnose the disease which it is called on to treat, at a stage which permits of effective therapeutic attack, nor are all surgeons or radiologists prepared to offer the proper therapy. The facts are, at present, that at least half of the malignant tumors which occur are so inaccessible as to render an early diagnosis in no sense possible, and, in addition, even the accessible tumors are so rarely diagnosed in the early stages that only about 20 per cent are susceptible of operative treatment, with a probability of cure. A small percentage of the inoperable tumors are available for curative radiation therapy.

The pathologist is assuming a position of importance which he has not held since tumor diagnosis began. Pathologic control is important in modifying the present attitude of some surgeons, that the breast of any woman over 35 years of age, containing a few nodules, should be promptly removed *in toto*. In the vast majority of cases, the diagnosis, whether on frozen or embedded material, rises no higher than the intelligence of the pathologist and the breadth of his experience. The need for better training of pathologists is stressed, and interesting suggestions are made as to methods of carrying this out. The pathologist of the future is to be called on to state the degree of malignancy of a tumor, and whether or not it is radiosensitive. Malignancy, it should be remembered, is a clinical phenomenon—not a morphologic one. The clinician and the pathologist must be much better trained in the diagnosis of tumors than they are at present.

C. G. SUTHERLAND, M.D.

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**Primary Carcinoma of the Lungs and Bronchi. E. V. Goltz. Minnesota Med., September, 1930, XIII, 605.**

The increase in carcinoma of the lung is not wholly apparent, but there is evidence to show that it is actual. Primary carcinoma of the lungs may arise from the columnar epithelium of the bronchi, from the mucous glands of the bronchi, or from the squamous epithelium of the alveoli. The forms arising from the bronchial epithelium vary greatly in size, color, and consistency; they may remain as small local nodules, with wide metastases, or may grow extensively into the lung tissue. Sooner or later there is obstruction to a bron-

chus. The type arising from mucous glands is rare and usually limited to the walls and submucosa of the bronchi. Those types arising from the pulmonary alveolar epithelium may be diffuse over a large area, or may be multiple and nodular. Primary carcinoma of the lung is prone to metastasize. A careful history will usually focus attention on the lungs, when physical examination and special examinations by bronchoscope, by X-ray alone or after lipiodol injection will give conclusive evidence. The X-ray examinations should be repeated to observe progress. Therapy by X-ray may relieve pain, but progress of the lesion is rarely ever affected.

W. W. WATKINS, M.D.

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**Some Notes on the Diagnosis of Carcinoma from the Blood Serum. Howard M. Jamieson. Illinois Med. Jour., January, 1931, LIX, 40.**

The writer gives a history of the various serological tests which have been used in an attempt to make an early diagnosis from blood serum. He has found a modified Botelho test most satisfactory.

The reagents used and the technic are as follows:

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|---|---|
| Reagent No. 1: | |
| Formalin | 1 c.c. |
| Sodium citrate | 0.25 gram |
| Citric acid | 4.74 grams |
| Pure iodine crystals | 1 gram |
| Distilled water to | 100 c.c. |
| Reagent No. 2: | |
| Pure iodine crystals | 1 gram |
| Potassium iodide | 2 grams |
| Distilled water to | 210 c.c. |

The test is carried out by adding 0.25 c.c. of serum to be tested to a small test tube containing 2.0 c.c. of Reagent No. 1. Mix thoroughly without foam and add 0.7 c.c. of Reagent No. 2 slowly from a pipette. A flocculent precipitate forms which, in most cases, dissolves on thorough mixing (in all cases in which a normal or non-cancerous serum is being tested). A further 0.2 c.c. of Reagent No. 2 is added, forming a further precipitate which persists after mixing, if the reaction is positive.

Reactions are graded as follows:

| | | |
|---|---|---|
| Heavy precipitate after | 0.7 c.c. | 4 plus |
| Light precipitate after | 0.7 c.c. | 3 plus |
| Heavy precipitate after | 0.9 c.c. | 2 plus |
| Light precipitate after | 0.9 c.c. | 1 plus |

No precipitate negative.

All 1 plus reactions should be considered as doubtful, and should be repeated, with a new specimen of blood, if possible. The author believes a positive Botelho test, with an increased antitryptic index, especially if this be 3.0 or over, sufficient to warrant a diagnosis of cancer in any suspicious case.

He arrives at the following conclusions:

1. The most important thing in connection with cancer is an early diagnosis.
2. Of the several available tests, the most promising are the Botelho reaction and the antitrypsin index estimation used together.
3. Too much confidence should not be placed on either test used alone.
4. The Botelho test may be doubtful, but never really negative, in cases of cancer which have been treated with radium, while treatment by the X-ray does not seem to affect the reaction.
5. The reaction may be doubtful, but never really positive, in cases of syphilis treated with arsphenamine, but not in other methods of treatment. It may, however, be definitely positive in cases of degenerating gummas.

C. H. DEWITT, M.D.

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## CANCER (THERAPY)

**The Present Status of the Treatment of Carcinoma of the Cervix Uteri. Erwin Zweifel. Am. Jour. Obst. and Gynec., November, 1930, XX, 595.**

The author comprehensively reviews the works and recommendations of various authorities on this subject, in both the fields of gynecology and radiology. The difficulty in appraising and comparing the relative cures obtained by the different methods, is cited. This difficulty is due to the personal equation entering into the grouping of the cases. The absolute cures are comparable, and he states that

the results in the best published statistics on treatment by irradiation are about the same as the results in the best published statistics for surgery.

The advantages enjoyed by irradiation are the absence of fear in the patient, resulting in earlier treatment; the low immediate mortality; its value in both operable and inoperable cases; the constant advancement and improvement in technic, while surgery has reached a *status quo*. The disadvantages of irradiation are the complications which may result even with the most careful technic just as in surgery, or inadequacy of the treatment. Proficiency in radiation therapy is more difficult to achieve than proficiency in surgery.

The treatments available are surgery, irradiation, or a combination of the two. Radiation therapy should always have a definite place in the plan of treatment for uterine carcinoma. The value of irradiation is conclusively demonstrated in the statistical reports of various authorities, in which their cures were doubled by routine post-operative irradiation over their cures by surgery alone, which include reports by Kroenig and Gauss, Warnekros, Zacherl and Lundwahl, Adler, Breitschneider, Giesecke, Lehotsky-Semmelweiss, and many others. The value of routine post-operative irradiation in carcinoma of other structures, as the ovary, breast, etc., has been conclusively demonstrated by Seitz and Wintz, Eymer, v. Franque, v. Jaschke, Strassmann, Schaefer, Breitschneider, Flatau, Aubert, E. Zweifel, Meyer, Buchholz, and others. Stoeckel combines pre-operative radium therapy, radical surgery, and post-operative roentgen therapy.

The author, a gynecologist, concludes that surgery and post-operative irradiation combined, give better results than surgery alone. The relative value of surgery and radium is not determined.

The discussions by Ward, Brettauer, v. Mikulicz, Healy, Stone, McGlinn, Taussig, Farrar, and Zweifel are well worth reading.

JACOB H. VASTINE, M.D.

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**A Clinical Evaluation of Radium and Roentgen Therapy in Advanced Cancer, with Various Combinations of Wave Lengths. Bernard P. Widmann and J. L. Weatherwax. Am. Jour. Roentgenol. and Rad. Ther., November, 1930, XXIV, 540.**

The authors are of the opinion that the progress of radium and roentgen therapy must depend upon the development of physical principles and technics which permit the delivery of greater quantities of radiation to the tumor areas. Clinical experience indicates that certain cancers are radiosensitive and radioresistant. Highly cellular cancers are extremely malignant and also highly radiosensitive. The authors maintain that the "skin erythema dose" should be standardized. They have found 800 r to be a safe erythema dose, from an experience of 15,000 doses of roentgen rays. Clinical results point to a selective action of gamma radium rays (with filtration equivalent of 2 millimeters of platinum). Combinations of different short wave lengths of roentgen rays, in conjunction with gamma radium packs to the same skin area, will increase the skin tolerance for radiations 30 or 40 per cent. Clinical impressions justify the inference of improved end-results in advanced cancer by the systematic application of combined short wave length radium and roentgen rays.

J. E. HABBE, M.D.

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**Modern Methods in the Treatment of Carcinoma. Fraser B. Gurd. Canadian Med. Assn. Jour., December, 1930, XXIII, 784.**

This paper is based on observations made during a somewhat prolonged trip to several of the more important British and European clinics.

Despite the fact that the injection into the body of certain colloidal substances, more especially lead and selenium, have been followed in a small number of cases by good results, the usefulness of such a procedure has been very problematical. During recent years there have been added to surgery, as means of combating cancer, three new methods, electrocoagulation, X-rays, and radium. Electrocoagulation has the advantage, as compared with the scalpel, of not running the risk of spread-

ing cancer cells, and so has gained for itself a definite place in the attack on carcinoma.

The use of radium in the treatment of cancer has opened up an entirely new field. Special attention has been attracted to the subject since the publication of the work of Professor Forssell, of Stockholm. The Stockholm method of treatment of carcinoma, by means of radium and X-rays, differs from that practised in Paris and Brussels, and that used for the most part in London, in that larger doses of radium are employed for shorter periods.

In the treatment of skin cancers at Stockholm, the radium plaque is used for rodent ulcers. For other skin cancers, intubation is used. In the treatment of carcinoma of the lower lip, for instance, of the size of a ten-cent piece, five or six tubes, 1.5 cm. in length and containing 10 mg. of radium each, with a platinum-gold filtration equal to 1.0 mm. of lead, are inserted about and beneath the tumor. These are removed in from two and a half to four hours.

The Stockholm clinic is very enthusiastic about the use of the radium bomb or "telecurie therapy," as it is called in Paris and Brussels. They have two bombs, one containing from one to two grams of radium, and the other five grams. Radon is not used in Stockholm, chiefly, it would appear, because they believe it is dangerous for the technicians preparing the seeds or tubes.

Roentgen-ray therapy is extensively used, as is electrocoagulation, the latter especially in the case of mouth tumors and in carcinoma of the vulva. A common routine in the mouth tumors is, first, the X-ray, then electrocoagulation, and, at the same sitting, the insertion of radium tubes.

At Stockholm, in contrast with London, radium is not employed in carcinoma of the breast, except in cases of local or glandular recurrences. The routine treatment is one or two pre-operative courses of X-radiation, employing five ports of entry. The total dose over each port during each course is one or one and three-quarters of an erythema dose. Operation is undertaken six weeks after the last pre-operative radiation. Following operation, one, two, three, or sometimes four post-operative radiations are carried out at intervals of from three to six months.

Buccal tumors are treated in Stockholm by means of electrocoagulation. In the anterior two-thirds of the tongue, the tissues immediately about the coagulated area are intubated with radium tubes.

They do not use radium in carcinoma of the rectum.

The most striking thing about the Stockholm clinic is the thorough organization for the protection of the operators as well as in the "follow-up" of the treatments. In Paris, the author found the work with radium much less organized for observation than that in either Stockholm or London, and, inasmuch as the work in London is largely based on that done in Paris, he believes it is better for the visitor to spend more time in London than in Paris. In London the treatment of carcinoma of the breast is carried out extensively by means of radium implantation. The work of Dr. Geoffrey Keynes, at St. Bartholomew's Hospital, and that of Dr. Stanford Cade, at Westminster Hospital, are specially mentioned. Dr. Cade has added to the method of implantation, that of distance radiation by means of radium in Columbia paste shields applied to the front and back of the chest. Cade, however, does not support the use of radium to the exclusion of surgery in the early cases. In London, they are not as enthusiastic about the use of the radium bomb as they are in Stockholm. The author does not believe the London technic in the use of the bomb is as good as that of Stockholm. At St. Bartholomew's Hospital both radium needles and radon seeds are used, but the physicians there believe the use of the needles is the better procedure.

In the treatment of carcinoma of the mouth, including the tongue, buccal mucosa, pharynx, and the palate, Cade depends entirely upon the use of radium and does not employ coagulation. In the treatment of the glandular areas, he uses block dissection of one or both sides of the neck, and follows with a radium collar after the wound is healed.

In the treatment of cancer of the rectum, Cade believes that ultimately a radium technic will be evolved which will be superior, but at

the present time surgery should be employed in the operable cases.

L. J. CARTER, M.D.

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**Cancer of the Breast. Albert Soiland. Jour. Cancer Research, March, 1930, XIV, 128.**

The writer is convinced that treatment of breast carcinoma in all stages would be effective if early radiation were instituted, regardless of whether or not surgery is undertaken. Post-operative radiation has probably added 10 per cent to the so-called clinical or five-year cure of all breast cases operated on. The author questions the value of several recent statistical reports showing five-year results in breast cancer obtained by surgery only, radiation alone, and by the combination of the two means. He feels that these reports are not fair to radiology, because the radiation therapy was not administered in many instances by those competent to do so in a scientific manner, and with adequate equipment. He feels that in the absence of any other apparent curative agent, radiation promises to become the active treatment factor in cancer of the breast, with surgery as an ally for general reconstructive work.

JOHN R. CARTY, M.D.

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**The Treatment of Carcinoma of the Tongue. Milton Friedman. Med. Jour. and Record, Sept. 17, 1930, CXXXII, 284.**

In planning the treatment of a case of carcinoma of the tongue, the therapist must first decide which objective to aim at: cure or palliation. Radiation is dangerous and either kills or cures, and only experience can teach one to differentiate between hopeless and favorable cases. In the preliminary treatment, external radiation by high voltage X-rays is directed to both sides of the neck, which should total four 25 per cent erythema doses to each side of the neck. If the tumor responds at all to this, the dose should be repeated before going on to local treatment. Interstitial radiation with radium needles is the best for local treatment. The author advocates platinum needles 27 and 35 mm. in length, each with 2 mg. of radium. These should be inserted around the periphery of the lesion. Each needle should remain in place 100 hours, so that 200 milligram-hours may be delivered to each cylindrical area 1 cm. in circumference. The glands draining the tongue area should be thoroughly removed by surgical excision. If a persistent, painful radium scar or ulcer results, it should be excised with the endotherm knife.

W. W. WATKINS, M.D.

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**Diet of Carcinoma Patients. W. Caspari. Strahlentherapie, 1930, XXXVII, 719.**

The author discusses briefly the present status of our knowledge concerning the influence of diet on carcinoma in man. From a study of the literature, it appears that the diet must not be too rich. It should not be limited, however, so much that there is danger of under-nourishment. A few carbohydrates, fresh vegetables, and sugar are recommended; a certain amount of bread and some potatoes are permissible. Albumin and fat can be given freely. The desirable administration of Vitamin A is best carried out by feeding cod liver oil. Uncooked food is contra-indicated; large amounts of eggs and milk should be avoided; no liver or tomatoes should be given. Salt may be used according to the habits of the patient. This type of diet is meant for patients after operation or irradiation. Plenty of fluid should be taken first and then gradually reduced. A regular function of the bowels is very important.

ERNST A. POHLE, M.D., Ph.D.

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**The Radium Treatment of Cancer of the Tongue (Symposium). Stanford Cade. Canadian Med. Assn. Jour., December, 1930, XXIII, 771.**

This symposium was contributed, at the meeting of the British Medical Association in Winnipeg, by Stanford Cade, of London; Douglas Quick, of New York, and G. E. Birkett, of Manchester. In many respects there was a remarkably close agreement among these three workers, and as a result there emerged a fairly authoritative declaration on the radium treatment of buccal carcinoma.

For treatment of the primary growth all were

agreed on the advantages of radiation over surgery, but whereas Cade and Birkett favored radium needles, Quick preferred radon seeds. In the opinion of the first two authorities it was difficult, with seeds, to obtain a uniform intensity of radiation, not only because the intensity of radiation rapidly diminished within a period of four days, but also because the small seeds could not be so accurately placed as the larger needles.

For the treatment of operable metastases of the neck, all the speakers favored free surgical excision. When there were large inoperable metastases the glands should be actively treated by radium needles in large doses, and the balance of opinion favored open operation as the method by which this should be carried out. For early cases in which no palpable metastases could be found there was sharp divergence of opinion as to the method of treatment to be employed. Birkett advocated a waiting policy, provided the patient reported for examination once a month. Cade and Quick, on the other hand, believed that the neck should never go untreated. Cade advocated treatment by needling, using the closed method, or external treatment by means of the radium collar. Quick employed heavily filtered high voltage X-radiation, and more recently a 4-gram radium element pack. Speaking of the radium bomb at the Westminster Hospital, Cade felt that it was not an economical method of using radium Quick stressed the importance of cleaning the mouth before treatment was begun. The general impression given out was that radium was superior to surgery alone.

L. J. CARTER, M.D.

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**Carcinoma of the Cervix Uteri. Cornelius Oliver Bailey. Texas St. Jour. Med., September, 1930, XXVI, 351.**

Since 30 per cent of cancer in the female involves the uterus, and 90 per cent of uterine cancer originates in the cervix, the consideration of this lesion is of great importance. The earliest stages of the disease appear as (1) a hard nodule in the substance of the cervical lip, (2) papillary outgrowths from the lip or the canal, or (3) excavation or cauliflower growth. Cervical cancer involves the pelvic nodes in less than one-third of the cases. The treatment of cancer is both educational and technical. From the technical standpoint, there is a two-fold problem: (1) eradication of the local lesion and maintenance of body resistance at the highest point of efficiency; (2) the study of the general condition of the patient in order that the natural body resistance to cancer may be kept at the highest point of efficiency. The treatment and prognosis are largely dependent on intelligent study of the biopsy specimen, and no line of treatment is justified until a pathological report is available. The method of treatment advocated is usually from four to six thousand milligram-hours of heavily filtered radium to the cervix and broad ligament regions. This is supplemented with medium wave roentgen-ray therapy in massive doses over the pelvis by "cross-fire" distribution. After this a "follow-up" system is essential to the proper handling of the cases.

W. W. WATKINS, M.D.

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**Factors Influencing the Treatment of Rectal Cancer. George E. Binkley. Jour. Am. Med. Assn., Dec. 27, 1930, XCV, 1971.**

The treatment of rectal cancer is a perplexing but interesting problem, on account of the variable factors associated with this disease at the time a definite diagnosis is determined. Early recognition of rectal cancer, while the tumor is small and the disease is localized, offers many advantages to successful treatment. The two methods of treatment that have proved of greatest value in this disease are radiation therapy and surgery. In a miscellaneous group the best results are obtained by varying the dosage and technic in accordance with the clinical and pathological features of the given case.

The two forms of radiation therapy that have proved of greatest value in deep-seated tumors are external applications of radium and roentgen rays, and interstitial applications of radon, filtered by 3 mm. of gold. The surgical procedures that offer the greatest possibilities are the abdomino-perineal and the perineal types of operation, while a colostomy affords a certain degree of palliation in the

inoperable group. It appears more appropriate now to classify cases as favorable and unfavorable. Favorable patients are those presenting strong possibilities of being rendered free from disease by surgery, radiation therapy, or the combined use of radium and surgery. Unfavorable patients are those suited only for palliative measures. The physical condition of the patient should receive primary consideration, as the severity of the treatment should not exceed his endurance. Moreover, the degree of palliation in the unfavorable group frequently depends upon the physical condition. The anatomic location and the accessibility of the cancer within the rectum may greatly influence the selection of treatment. Through recognition of the type of malignancy before treatment is undertaken, many patients with incurable, highly malignant cancers will be saved the unnecessary annoyance of radical procedures. On the other hand, patients with tumors of the lowest degrees of malignancy will be rendered free from disease or provided with the highest degree of palliation. The grade of malignancy suggests a solution of the problem in determining the most appropriate type of operation. A moderate sized, low-grade rectal cancer, in which the disease appears to be more or less localized, may be completely eradicated by surgical dissection, while a similar surgical procedure in the case of a tumor of the highest grade of malignancy, but similar in size and fixation, is more likely to be detrimental than beneficial. Highly malignant tumors are cellular and usually radiosensitive and require a comparatively small dosage. Overdose in this type tends to produce necrosis and sloughing. In certain instances the employment of interstitial irradiation is contra-indicated. Tumors of low-grade malignancy lend themselves well to interstitial irradiation, although they require for devitalization a comparatively large dosage of gold seeds. Cancers occurring in patients below the age of 30 are usually highly malignant.

A long history of mild subjective and objective symptoms, associated with a comparatively small tumor, without deep infiltration, suggests a low malignancy, while a sudden onset of severe symptoms, accompanied by a comparatively extensive mass, indicates a more highly active process. The most adequate determination is by the combined application of the clinical and histologic studies.

CHARLES G. SUTHERLAND, M.D.

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**Cancer of the Esophagus: Analysis of Eighty-two Cases. E. P. McCullagh. Med. Jour. and Record, Sept. 17, 1930, CXXXII, 288.**

This study includes 82 cases seen at the Cleveland Clinic for the period from 1921 to 1928. Of these, 77 per cent were men, the average age being 59 years. No patient recovered, the average duration of life in men being 9.9 months and in women 12.5 months. Fifty-seven patients received some sort of treatment.

In 92 per cent of 74 cases in which an X-ray examination was made, a positive diagnosis of cancer of the esophagus was made. In 9 cases the examination failed to show the lesion on the first examination; in 2, a second examination identified it. One case, positive on X-ray examination, was negative to esophagoscopy, but was found to be positive three months later. Cardiospasm was diagnosed by esophagoscopy in one case, while the X-ray revealed a definite growth one month later. Fifty-seven patients received some sort of treatment; X-ray was employed in 14 cases, radium in 16, gastrostomy in 17, dilatation in 7, and esophagectomy in 3.

Surgical removal of cancer of the esophagus is a formidable procedure and hardly justified. The best treatment is the application of radium through an esophagoscope, and this does little good. A few cases have been reported as benefited by the X-ray.

W. W. WATKINS, M.D.

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**Present Methods of Radiation Treatment of Carcinoma and Their Results. III.—The Saturation Method of Pfahler and Kingery. Hans Holfelder. Strahlentherapie, 1930, XXXVII, 696.**

The principles of the saturation methods as advocated by Kingery and Pfahler are briefly discussed. One of the author's assistants studied the skin reactions following exposure

to roentgen rays by using different intervals. The preliminary results are given and illustrated by two photographs of the irradiated skin.

ERNST A. POHLE, M.D., Ph.D.

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**The Treatment of Carcinoma of the Body of the Uterus. William Neill, Jr. Am. Jour. Roentgenol. and Rad. Ther., October, 1930, XXIV, 412.**

Adenocarcinoma of the body of the uterus is rarer than cervical cancer, grows more slowly, and tends to remain restricted to its primary corporal origin. Metastases to distant or neighboring structures, however, are more common than in the cervical group. In this paper the author emphasizes his treatment of this disease with radium, reporting results and the percentage of five-year cures. Taking all groups treated at the clinic prior to five years ago, there were 109 patients; 76 have died, counting 6 patients lost sight of as dead, and 33 are living, making a total five-year-cure rate of 33 per cent. The author does not attempt a prognosis from the standpoint of histological grading. He concludes that, as with cancer elsewhere, the greatest hope for cure lies in an early diagnosis. In operable carcinoma of the body of the uterus, radium offers a method of treatment comparable to surgery, as it obviates the primary mortality and can be used safely in those cases presenting bad surgical risks—it offers the possibility of a cure or definite palliation to a number of inoperable and recurrent cases. When there is any doubt as to the extent of the disease, operation alone or operation combined with radium therapy is the treatment of choice.

J. E. HABBE, M.D.

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**The Principles of and Some Results in the Radium Treatment of Buccal Carcinoma. G. E. Birkett. Canadian Med. Assn. Jour., December, 1930, XXIII, 780.**

This paper is the final contribution toward the symposium on radium therapy in cancer of the tongue, abstracted on page 587.

Radium has improved out of all recognition the outlook in buccal carcinoma. All squamous epitheliomas of the mouth and tongue are radiosensitive, some more so than others, and there is now unanimity of opinion that prolonged irradiation with gamma rays of low intensity yields the best results. The problem, then, should be mainly one of the insertion or application of the radium. The author is unhesitatingly in favor of using radium needles in preference to seeds.

Metastasis to the cervical glands, which always occurs by embolism, cannot be adequately treated either by external radiation or by blind insertion of needles through the skin. The author's practice is to reflect flaps, as in a block dissection of the neck, divide the sternomastoid, and insert needles in the anterior and posterior triangles about 2 cm. apart. These are left in position about eight days.

The results of treatment in the author's series of cases is as follows: 38.7 per cent 3-year "apparent cures"; 47.3 per cent 2-year, and 60 per cent 1-year, for the primary site. When the primary and secondary sites are considered, the percentages are 27.5, 36, and 45, respectively. Improvement in results will depend on several factors: the two most important are earlier diagnosis and concentration of radium treatment at larger centers.

L. J. CARTER, M.D.

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**Malignancy of the Body of the Uterus. O. L. Norsworthy. Texas State Jour. Med., October, 1930, XXVI, 440.**

In a series of 264 cases of cancer of the uterus examined from 1921 to 1928, 42 were corpus cases, two of which were sarcoma, two were chorio-epithelioma, the others being the usual adenocarcinoma. Of these, 27 were treated with radium alone, and 15 with radium and hysterectomy. Of the 27 patients treated with radium, 11 are living and well five years after treatment; of the 15 treated by radium and hysterectomy, five are living and well at the end of five years. While 42 is not a large enough series from which to draw conclusions, the number suggests that irradiation may become the treatment of choice for malignancy of the body, just as it has in malignancy of the cervix.

W. W. WATKINS, M.D.

**Treatment of Intra-oral Cancer, with Special Reference to Radium Therapy. Douglas Quick. New York St. Jour. Med., Sept. 15, 1930, XXX, 1094.**

Practically all our experience with radium has been gained during the past fifteen years, and a certain number of failures during this period must be charged up to the accumulation of experience. Surface applications were first used, but were discontinued as far back as 1917, with only three cases in which complete and permanent regression of the disease was obtained. From 1917 to 1925 results improved through the use of unfiltered emanation seeds. In 1925, these were replaced by the gold emanation tubes which filter all the softer rays, lessening the local reaction, pain, and necrosis.

The treatment of intra-oral cancer is a surgical problem and must be approached as such. The radium irradiation is the backbone of treatment of intra-oral cancer. Radium must be accurately placed and with accurate dosage, and other associated measures must be used. X-radiation is a necessary complement in all cases of intra-oral cancer, unless large amounts of radium are available for distance radiation. Operative surgery is frequently necessary in the mouth for drainage, for access to growth, and for dealing with disease in bone; also in the neck in early, definite involvement of adult epidermoid carcinoma. Four hundred and seventy-three cases of cancer of the tongue are reported upon, of which 22.4 per cent were clinically free from disease for from five to ten years after treatment.

W. W. Watkins, M.D.

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**Uranium-thorium Colloid in the Treatment of Carcinoma. George T. Pack and Fred W. Stewart. Jour. Cancer Research, March, 1930, XIV, 152.**

The authors administered a mixed uranium-thorium colloid intravenously to eight patients with advanced carcinoma, according to the method of Hocking. There was evidence of temporary benefit in one case. In the other seven cases there were no signs of improvement of any sort. In two patients, there was evidence of kidney damage, although no autopsy confirmation was obtained. Autopsy was done upon two cases. The Kupffer cells of the liver showed the usual type of liver picture seen with many colloid metals. The spleen showed phagocytic material in the reticulo-endothelial apparatus. Desiccated liver and spleen were found to be radio-active, but the tumor tissue from the same cases showed no evidence of radio-activity.

John R. Carty, M.D.

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**Radium Treatment of Cancer of the Tongue. Stanford Cade. Canadian Med. Assn. Jour., December, 1930, XXIII, 771.**

This paper is a contribution toward the symposium on radium therapy in cancer of the tongue, abstracted on page 587.

In the last few years this form of therapy has made rapid strides, following the results obtained by Regaud, who introduced the method of needling, now in most general use. In the series of cases under review, all were treated except those with a life-expectancy of only a few weeks. No attempt is made to separate the operable from the inoperable group.

All the cases were treated by implantation of radium needles into and around the tumor, seeds being used exceptionally when local conditions demanded them. The needles used contained 0.6 mg. and 1.3 mg. of radium, and were fully screened by 0.5 mm. and 0.6 mm. of platinum, respectively. The period of treatment was seven days. The amount of radium used depended on the extent of the disease. Treatment of the primary lesion was nearly always followed by treatment of the lymphatic area in the neck, either by needling through the closed method or by use of a radium collar.

The cases treated cover a period of five years, from April, 1925, to April, 1930. The total number was 253, distributed as follows: tongue, 169; cheek, 23; tonsil, 12; palate, 28; lip, 21.

Disappearance of the primary lesion was obtained in 126 cases, that is, 74 per cent. The number of local recurrences, as distinguished from primary failures, was 43, that

is, 25 per cent. In many of these latter the lesion was completely eradicated by subsequent treatment. The percentage of cases requiring a second treatment was definitely greater among those treated by radon seeds than among those treated by needles.

The main conclusions reached are: (1) the superiority of needles, and (2) the necessity of treating *all* cases over the cervical gland area. Here needling by either the closed or open method is preferred to surface application.

L. J. CARTER, M.D.

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**Radium and Surgery in Cancer of the Tongue. Douglas Quick. Canadian Med. Assn. Jour., December, 1930, XXIII, 774.**

This paper is another contribution to the symposium on radium therapy in cancer of the tongue, abstracted on page 587.

Two points are emphasized: (1) that the combined use of radiation and operative surgery offers several advantages in the treatment of epidermoid carcinoma in general, and (2) the treatment of epidermoid carcinoma is steadily approaching a more reasonable, accurate, and efficient basis.

Histologic study of the relative degrees of cell differentiation or potential malignancy of tumor processes has been most enlightening from the therapeutic standpoint. It shows very clearly the reason for surgical failure in many instances, and at the same time explains some of the most spectacular reactions to radiation. The undifferentiated growth, highly malignant, prone to early and widespread dissemination through both lymphatics and blood stream, presents obviously a poor surgical risk. On the other hand, it is highly radiosensitive. The fully differentiated tumor process is more orderly in its development. Metastasis occurs, as a rule, later in the disease, and even then tends to remain within a limited area. In such cases it is but reasonable to expect relatively better results from operative measures. The more adult the growth the more radioresistant it becomes. The reaction to radiation is not nearly so spectacular, and yet, if the process be controlled by this means, the assurance of permanency of the result is much greater.

Martin and Quimby have shown that adult epidermoid carcinoma requires from seven to ten erythema doses throughout the tumor-bearing area to produce complete and permanent control of the growth. The anaplastic growths, on the other hand, respond completely to a dosage range of from three to six skin erythemas, depending on the relative degree of differentiation.

As three skin erythema doses is the safety limit for safe irradiation of the tongue by external methods, it is evident that this must be supplemented by some means in the case of growths showing any degree of cell differentiation. Interstitial radiation must be employed.

Inasmuch, then, as treatment detail is based on the histology of the growth it is essential that a biopsy be done early and in all cases. The theoretical objections to this procedure are overridden by the advantages of the information obtained.

Oral hygienic measures are of prime importance.

In the Memorial Hospital the same principles of treatment are followed as presented before the First International Congress of Radiology in London, 1925, and published in the *British Journal of Radiology*, March, 1926. External radiation of greater intensity than formerly employed is now being used, augmented recently by a radium pack of 4 grams. For interstitial radiation, radium emanation, or radon, in gold capillary tubes, with a filtration of 0.3 mm. gold, is employed.

If the growth be bulky, fungating, and markedly infected, the implantation is followed in a few days by cautery removal of the condemned area.

Secondary invasion of bone by growth, infection in bone, or devitalized bone caused by irradiation, calls for surgical removal.

The treatment of the lymph nodes in the neck consists of heavily filtered external radiation of the maximum intensity consistent with tissue tolerance, and from both sides. If a palpable node of adult type epidermoid carcinoma is present, complete unilateral dissec-

tion is done under local anesthesia. Before the wound is closed, filtered radon seeds are implanted at any suspicious points. No postoperative radiation is employed. If the node is inoperable, no dissection is attempted, but radon seeds are implanted. All necks with bilateral metastatic nodes are regarded as being surgically inoperable, and incurable except in very rare instances. External radiation is used as a palliative measure only in these advanced cases. Metastatic nodes from anaplastic epidermoid carcinoma are treated by radium alone, used externally in most instances, but supplemented by implantation of radon tubes.

An analysis of ten-year clinical results is appended.

L. J. CARTER, M.D.

## CHEMICAL[1]

**The Crystal Structure of Silver Cyanide. H. Braekken. Kgl. Norske Videnskabers Selskab., Trondhjem, Forhandlinger, v. 2, 1929, II, Medd. No. 48, 169.**

AgCN recrystalled from $Na_2CO_3$ or $K_2CO_3$ solutions showed the same diffraction pattern as the original powdered material. The crystals were needles, 3–4 mm. in length, and showed prisms of the first order, though a few with second-order prisms were found. The crystals are of the hexagonal quadratic form. Laue photographs show a ditrigonal roentgen symmetry. The parameter is 4.60 Å.U. and the angle 81°14′. The space group is $C_3^5v$. Ag ions are located 3.5 Å.U. from C or N. The forces are strongest in the direction of the needle axis. Braekken proposes to call this type a chain lattice, a linear analog of layer lattices.

CHEMICAL ABSTRACTS.

**Structure Produced by Rolling of Metals. E. Schmid and G. Wassermann. Metallwirtschaft, 1930, IX, 698.**

A piece of technical sheet zinc was cold-rolled in one direction to a thickness of 0.02 mm. and X-ray photographs taken at various angles to the sheet in three planes: (1) in the direction of rolling, (2) perpendicular to and (3) at an angle of 45° to the direction of rolling. The photographs are summarized in a pole diagram showing the position and the intensity of the base faces. The same procedure was followed with a piece of magnesium annealed 1.5 hours at 600° and cold-rolled to 0.03 millimeter. The orientation of Mg is much simpler than that of Zn. The formation of the orientation of the two metals is explained by the changes in the single crystal, and the characteristic difference by the difference in the mechanical twinning. The heterogeneity of the orientation of rolled Zn is proved by preliminary tests.

CHEMICAL ABSTRACTS.

**X-ray Study of Certain Esters of Cellulose and of Glucose. A. Nowakowski. Compt. rend., 1930, CXCI, 411.**

Distearic and dilauric esters of cellulose showed only a microcrystalline structure, and no fiber pattern; but fiber patterns were obtained from pentacetic, pentalauric, and pentapalmitic esters of glucose, with an identity period along the fiber axis 5.28–5.39 Ångström units. The fibrous forms of these esters have fibers all in the same direction, with the aliphatic acid chains at right-angles to the length of the fiber.

CHEMICAL ABSTRACTS.

**False Lines in X-ray Grating Spectra. J. M. Cork. Phys. Rev., Aug. 15, 1930, XXXVI, 665.**

Certain false lines may be obtained on the photographic plate in addition to those due to defects in the grating because of the generally employed arrangement of slits, X-ray source, and diffraction grating in X-ray spectroscopy.

CHEMICAL ABSTRACTS.

**Orientations of the Molecules in Naphthalene and Anthracene Crystals. Kedareswar Banerjee. Indian Jour. Physics, 1930, IV, 557 (cf. Chem. Abs., XXIV, 3410).**

It has been found that the intensities of X-ray diffraction from naphthalene and anthracene crystals do not conform to the ori-

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entations of the molecules along any cell face. By the "trial and error" method of analysis it has been found that the molecules are inclined to the cell faces, the correct positions being obtained by first placing them along the plane and then by two successive rotations about the *"b"* and the *"c"* axes. The rotations about the *"b"* axis for the two molecules in the unit cell are equal but opposite, while about *"c"* they are in the same direction in conformity with the space-group $C_{2h}^{5}$. The amounts of rotations for naphthalene are 25° and 12°, respectively, and those for anthracene are 25° and 9°. All the benzene rings in the same molecules are in the same plane and the rings are practically regular hexagons. The structure obtained, as the result of the present investigations, is in conformity with the magnetic and optical properties of these crystals.

CHEMICAL ABSTRACTS.

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**Polymorphism of Sodium Sulfate. IV.—X-ray Analysis. F. C. Kracek and C. J. Ksanda. Jour. Phys. Chem., 1930, XXXIV, 1741.**

Three forms of $Na_2SO_4$ were detected: $Na_2SO_4$ I, stable 240°; $Na_2SO_4$ V, stable at ordinary temperatures, and $Na_2SO_4$ III, metastable below 185° but inert, when dry, at ordinary temperatures. X-ray patterns of the three forms and also of $Na_2SO_4.10H_2O$ are presented.

CHEMICAL ABSTRACTS.

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**Liquid Structure and X-ray Diffraction in Liquids. Kedareswar Banerjee. Indian Jour. Physics, 1930, IV, 541.**

A theoretical explanation of X-ray diffraction effects in liquids is presented, consisting essentially of the application of the Boltzmann principle, as originally employed by Raman and Ramanathan, to analyze liquid structure. The method is modified so as to take into account the nature of the field of force surrounding the molecules. The intensity distribution in the diffraction pattern is worked out. The liquid structure is a degeneration of the crystal structure brought about by the thermal agitations, and hence some of the intense crystal diffraction lines give rise to liquid diffraction maxima while others are quenched out. Simple cases of Na, K, A, and Hg are discussed fully and found to agree with the experimental results. Intensity distribution for rays diffracted by Hg is calculated according to theory and found to agree with the photographs given by Prins.

CHEMICAL ABSTRACTS.

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**The Crystal Lattice of Iron Silicide, FeSi. H. Möller. Naturwissenschaften, 1930, XVIII, 734.**

The results of Phragmen (Chem. Abs., XVIII, 3032) were verified. The compound was prepared from 33.0 g. Armco Fe and 17.0 g. Si in a Pythagoras crucible, Tammann furnace. Debye-Scherrer diagrams were made and measured. They gave a cubical translation lattice $T_c$ with $a = 4.467$ Å.U. From this and d. = 6.23 it follows that there are 4 FeSi in the unit cell. Only space group $T^4$ with Fe in $(uuu)$, $(u + \frac{1}{2}\bar{u} + \frac{1}{2}\bar{u})$, $(uu + \frac{1}{2}\bar{u} + \frac{1}{2})$, $(\bar{u} + \frac{1}{2}\ \bar{u}u + \frac{1}{2})$ and Si in $(vvv)$, $(v + \frac{1}{2}\bar{v} + \frac{1}{2}\bar{v})$, $(\bar{v}v + \frac{1}{2}\bar{v} + \frac{1}{2})$, $\bar{v} + \frac{1}{2} - \bar{v}v + \frac{1}{2})$ corresponds to the intensities measured, $u = 0.1340 \pm 0.0020$, $\bar{v} = 0.8445 \pm 0.0020$. The distances of Fe and Si are 2.24, 2.34, and 2.52 Å.U., min. for Fe–Fe 2.74 Å.U., Si–Si 2.76 Å.U.

CHEMICAL ABSTRACTS.

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**Absorption of X-rays by Lithium. K. C. Mazumder. Phys. Rev., 1930, XXXVI, 347.**

The mass scattering coefficient of lithium was measured for wave lengths 0.587–0.100 Å.U. For longer wave lengths the results can be expressed by the equation $\mu/\rho = 0.94\lambda^3 + 0.162$. Below 0.2 Å.U. there is a very rapid bending of the curve towards the axis $\lambda^3$.

CHEMICAL ABSTRACTS.

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**X-ray Diffraction in Liquid Hexamethylbenzene. P. Krishnamurti. Indian Jour. Physics, 1930, IV, 449.**

The liquid X-ray pattern consists of a strong inner halo (8.2 Å.U.) and a weak outer one (4.2 Å.U.), corresponding roughly to the [100] and [001] reflections of the crystal powder (7.7 Å.U.; 3.7 Å.U.). It is assumed

that the 4.2 Å.U. spacing of the liquid is caused by the thickness of the molecule; the other spacing represents periodicities in the plane of the benzene ring. The diminished structure-factor for the [001] spacing caused by the thermal agitation of the molecules in the liquid causes a diminution in intensity of the outer halo in the liquid. The outer rings of other benzene derivatives correspond to the thickness of the molecule.

CHEMICAL ABSTRACTS.

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**The Crystalline Structure of Hydrogen Sulfide and Hydrogen Selenide (II). G. Natta. Atti accad. Lincei, 1930, XI, 749; cf. Chem. Abs., XXIV, 4973.**

The structures of $H_2S$ and $H_2Se$ were studied on crystallized material by means of X-rays. At —170°, $H_2S$ has a cubic unicellular space lattice, $5.778 \pm 0.003$ Å.U. on a side; volume $192.8 \times 10^{-24}$ c.c.; containing 4 molecules of $H_2S$; density (calculated) 1.166. $H_2Se$ also has a cubic structure containing 4 molecules, side $6.020 \pm 0.005$ Å.U.; volume $218.2 \times 10^{-24}$ c.c.; density (calculated) 2.456.

CHEMICAL ABSTRACTS.

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**The Crystal Structure of Cadmium Chloride. Linus Pauling and J. L. Hoard. Ztschr. f. Krist., 1930, LXXIV, 546 (in English).**

The unit of structure for $CdCl_2$ is a rhombohedron, with $\alpha = 36°02'$ and $a = 6.23$ Å.U. containing 1 molecule. There is a layer structure along [0001], closely related to that of $CdI_2$. The Cl atoms are in approximate cubic close-packing. The relation of the $CdCl_2$ and the $CdI_2$ structures is discussed, and a list of similar compounds which crystallize in each type is given.

CHEMICAL ABSTRACTS.

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**The Absorption of Long Wave X-rays of 2–10 Å.U. in Light Elements. Bernhard Woernle. Ann. Physik [5], 1930, V, 475.**

This reports experimental determinations of the absorption coefficient of air, N, O, Ne, A, $SO_2$, $C_5H_{12}$ vapors and $CCl_4$ vapors in the range 2.3–9.9 Å.U., by means of a vacuum ionization spectrometer. A null method was used. From the experimental data, the coefficients of S, C, and Cl have been computed. The electronic absorption coefficient is not strictly a pure function of the product $Z\lambda$, systematic deviations being observed. The $K$ level absorption energy change was found for S, Cl, and A, and was approximately equal to the ration of the energy values of the $K$ and $L_1$ levels.

CHEMICAL ABSTRACTS.

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**Scattering of X-rays by Bound Electrons. Saligram Bhargava. Nature, Sept. 13, 1930, CXXVI, 398.**

Bhargava attributes the scattering noted by Dr. B. B. Ray (cf. Chem. Abs., XXIV, 3705) to a special case of photo-electric emission. A beam of frequency $\nu$ hitting a $K$ electron loses energy equal to $h\nu_k$ and will retain $h(\nu-\nu_k)$ which may either continue, or be absorbed by the electron which is then ejected. This has been used by de Broglie and Robinson to obtain the energy levels of atoms. Dr. B. B. Ray, in Nature, Sept. 13, 1930, CXXVI, 399 (cf. Chem. Abs., XXIV, 4213): The lines previously described as "modified lines due to the scattering of X-rays by bound electrons," would be better described as due to partial absorption of incident radiation by atoms. Further lines observed are given.

CHEMICAL ABSTRACTS.

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**X-ray Examination of Gelatin Micelles. W. Abitz, O. Gerngross, and K. Herrmann. Naturwissenschaften, 1930, XVIII, 754.**

The work of Katz and Gerngross has shown that gelatin gives a partly amorphous, partly crystalline X-ray diagram; stretched gelatin gives a collagen-like diagram. It appears on careful stretching that these diagrams are inter-related. The structure of gelatin is deduced in a manner similar to that for liquid crystals (Glamann, Herrmann, and Krummacher, Chem. Abs., XXIV, 4438) on the basis of parallel long stretched molecules. The polypeptide chains are arranged parallel to

each other over part of their length, thus giving an almost crystalline structure, without strict identity of the units. The ends of the chains are not closely bound together, so that the micelles appear more or less "frayed," causing the amorphous part of the X-ray diagram. The "frayed" ends of the chains produce the intermicellary coherence of the gelatin. Greater orientation and coherence of the chains and fewer "frayed" ends are found in collagen and in stretched gelatin. By the structure described several of the properties of the substance are explained.

CHEMICAL ABSTRACTS.

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**The Chemical and Crystalline Structure of Several Complex Nitrites. A. Ferrari and C. Colla. Atti accad. Lincei, 1930, XI, 755; cf. Giorn. chim. ind. applicata, 1930, XII, 142.**

The three nitrites $K_2PbNi(NO_2)_6$, $K_2PbCo(NO_2)_6$, and $K_2PbCu(NO_2)_6$ have similar cubic crystal structures, having 4 molecules for unit cell, and the sides and diameters are, respectively, 10.55, 10.49, 10.52 Å.U.; 3.5, 3.66, 3.56. 2 $K_3Co(NO_2)_6.3H_2O$ has a similar cubic structure with 4 molecules, and side 10.32 Å.U. Probably there is no water of crystallization, the $H_2O$ being enclosed in the space lattice, rather than held by the molecule itself.

CHEMICAL ABSTRACTS.

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**The Crystal Structure of the Normal Paraffins at Temperatures Ranging from that of Liquid Air to the Melting Points. Alex Müller. Proc. Roy. Soc., London, 1930, CXXVII-A, 417.**

An X-ray investigation has been made of the structures of a number of normal paraffins ranging from pentane to triacontane, at liquid-air temperature, atmospheric temperature, and near the melting points. Linear expansion measurements show that the lengths of both the *a* and *b* axes increase considerably with rise of temperature, the coefficient of expansion of the *a* axis being three or four times as large as that of the *b* axis. The expansion of the *c* axis is very much smaller, and does not exceed 0.1 of that of the *a* axis. These facts indicate that the forces which hold the atoms together in the molecule are different in magnitude from those which keep the molecules apart from each other; the chemical conception of the entity of the molecule is thus confirmed for the solid state. The higher members of the paraffin series crystallize in the so-called "normal" form previously described (Müller and Saville, Chem. Abs., XIX, 1692) which is found to be stable between the melting point and liquid-air temperature. Differences in the behavior of the odd and even members begin to appear as the number of C atoms decreases, docosane and lower members existing in two alternative forms. Within a small range of temperatures near the melting point the normal form is stable, but at lower temperatures a second crystal structure appears and persists down to the temperature of liquid air. The change from one form to the other is reversible for docosane, eicosane, and octadecane. The change from the normal to the other form occurs between undecane and nonane in the series of the odd members. These abrupt changes in structure are discussed and a qualitative explanation is suggested. Observations taken in the immediate neighborhood of the melting point indicate that these substances tend to form layer structures, and it is shown how the normal form could be transformed into such a structure in a simple manner.

CHEMICAL ABSTRACTS.

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**Crystal Structure of Normal Paraffins. S. H. Piper and T. Malkin. Nature, 1930, CXXVI, 278.**

Very pure specimens of four of the higher normal paraffins were classified according to Müller (preceding abstract). Hexacosane, $C_{26}H_{54}$ and tetratriacontane, $C_{34}H_{70}$, exist in two stable forms at room temperature, one with the normal *A* spacing, and the other about 4 Å.U. shorter, but obviously not the *B* "second form." Hexacosane took the *C* form when crystallized from $C_6H_6$ or EtOH, while a melted layer showed both *A* and *C* spacings. Tetratriacontane from $C_6H_6$ gave only *C* spacings, while melted crystals showed only

the *A* form. Triacontane, $C_{30}H_{62}$, showed the *A* form under all conditions. Even-numbered hydrocarbons of 26 or more C atoms seem to crystallize in the *C* form, while the odd-numbered nonacosane, $C_{29}H_{60}$, crystallizes in the *A* form. This alteration of crystal habit is in accord with the behavior of the normal aliphatic acids and alcs.

CHEMICAL ABSTRACTS.

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**The Crystal Structure of Cementite. Sterling B. Hendricks. Ztschr. f. Krist., 1930, LXXIV, 534 (in English).**

From data published by Westgren and Phragmen (Chem. Abs., XVI, 2291; XVIII, 2093), a complete structure determination is made for $Fe_3C$. The space group is $V_h^{16}$. Atomic positions are derived. The structure is of the co-ordination type.

CHEMICAL ABSTRACTS.

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**The Crystal Structure of $Fe_2P$, $Fe_2N$, $Fe_3N$, and FeB. Sterling B. Hendricks and Peter R. Kosting. Ztschr. f. Krist., 1930, LXXIV, 511.**

Examination of published data for $Fe_2P$, $Fe_3N$, $Fe_2N$, and FeB show that these compounds have a non-ionic co-ordination type of structure (cf. preceding abstract). $Fe_3N$ (cf. Chem. Abs., XXIII, 2408, 4387) is hexagonal with N at 000; ⅓, ⅔, ½; and Fe at 0, ⅓, ¼; 0, ⅔, ¾; ⅓, 0, ¼; ⅔, 0, ¾; ⅓, ⅓, ¾; and ⅔, ⅔, ¼. The unit cell contains 2 molecules and $a = 2.695\sqrt{3}$, $C = 4.362$ Å.U. For $Fe_2N$ the Fe atoms have the same positions as in $Fe_3N$, while N is at 000; ⅓, ⅔, 0; ⅔, ⅓, ½. Atomic positions are derived for $Fe_2P$ and FeB. For compounds of this type a polyhedron of metal atoms is formed around each non-metallic atom, the former equidistant from the latter. The polyhedra are regular or distorted, so that the metal atoms have, along some elements, approximately the separation characteristic of the metal. If a compound $R_aX_b$ consists of co-ordinated polyhedra having N corners, each corner is shared by $Nb/a$ polyhedra. The sharing is usually of corners only, sometimes of edges, and less often of faces.

CHEMICAL ABSTRACTS.

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**Structure Investigation of Silver Permanganate. Wilhelm Büssem and Karl Herrmann. Ztschr. f. Krist., 1930, LXXIV, 458.**

Both crystallographic and X-ray measurements were made on $AgMnO_4$. The crystals are monoclinic, the space group being $C_{2h}^5$. The unit cell contains 4 molecules and $a = 5.66$, $b = 8.27$, and $c = 7.12$ Å.U. The structure can be considered as a slightly deformed $KMnO_4$ lattice. A density determination gave 4.49.

CHEMICAL ABSTRACTS.

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**The Structure of Silicates. W. L. Bragg. Ztschr. f. Krist., 1930, LXXIV, 237 (in English). (Cf. Chem. Abs., XXIII, 5371.)**

This is a summary of the present knowledge of silicate structures. Individual minerals and isomorphous groups are described and discussed. The various structures are classified as: (1) orthosilicates, with independent $SiO_4$ groups; (2) complex Si–O groups, such as $Si_2O_7$ or $Si_6O_{18}$; (3) Si–O chains, as found in pyroxenes and amphiboles; (4) Si–O sheets, which are probably characteristic of mica-like minerals; (5) 3-dimensional Si–O networks. These groups show a progressive reduction in the Si–O ratio. There is a discussion of interatomic distances, isomorphous replacements, co-ordination numbers, and Pauling's rule of compensation as applied to silicates. Complete bibliography.

CHEMICAL ABSTRACTS.

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**Atomic Analysis by X-ray Spectroscopy. T. H. Laby. Trans. Faraday Soc., 1930, XXVI, 497.**

The X-ray method of detecting the atomic constituents of a substance is compared with other methods, *viz.*: (1) chemical, (2) optical spectroscopic, and (3) positive-ray methods. Spectroscopic methods are in general to be preferred to chemical ones when only very small quantities of the sample are available, or when the unknown substance is present in only very minute traces. The X-ray method has the following advantages over the optical: simplicity and relatively short range of the X-ray spectrum due to a given atom; certainty of identification of lines of

elements according to Moseley's law; the fact that, for elements of nearly the same atomic number, the intensities of corresponding emission lines, excited with equivalent excitation potentials, are in the same ratio as that of the respective numbers of atoms of the elements in the mixture. The last consideration makes possible the use of the X-ray method for other than very small concentrations, a condition necessary for the quantitative interpretation of results obtained by the optical method. The X-ray method is probably more sensitive than the optical, although sensitiveness depends to a great extent upon the elements investigated and experimental technic. Elements have been detected in concentrations as small as 1 part in $10^6$. The experimental methods of X-ray analysis are briefly discussed, and a short description and an illustration of the apparatus are included. The importance of a satisfactory experimental technic is stressed.

CHEMICAL ABSTRACTS.

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**Separation of Carbon from Carbon Monoxide in Iron. III.—The Formation of Iron Oxides and Iron Carbides in the Solid Phase. Ulrich Hofmann and Edeltraud Groll. Ztschr. f. anorg. u. allgem. Chem., 1930, CXCI, 414.**

O-free CO was passed over pure Fe, prepared from $Fe(CO)_5$. The solid phase was examined with X-rays by the method of Debye-Scherrer. Up to 450°, graphite and $Fe_3O_4$ were found with little Fe and $Fe_3C$; from 450° to 650°, graphite and FeO and small quantities of $Fe_3C$; from 450° to 650°, graphite and FeO and small quantities of $Fe_3C$, Fe and $Fe_3O_4$; above 655°, Fe, C and $Fe_3C$ but no FeO or $Fe_3O_4$. At 320° and 275°, CO was passed over pure $Fe_2O_3$. X-ray examination showed $Fe_3O_4$ and $Fe_3C$ in the solid phase. Unknown lines were attributed to a C-rich carbide, $Fe_2C$, which is unstable at higher temperatures. Benzine vapors passed over Fe at 700° together with O-free $N_2$ gave C, Fe and cementite in the solid phase. The results are discussed with reference to the phase diagram of Schenck (Chem. Abs., XXII, 2132). Attempts to detect oxoaustenite in the solid phase were unsuccessful. According to Schenck (Chem. Abs., XXII, 936), this occurs in carbonization above 575°. The $CO$-$CO_2$ analyses obtained at 700° are within this field but only cementite and α-Fe were found in the solid phase. The latter was cooled both in $H_2O$ and in liquid $N_2$ but since the mass is in the form of a fine powder because of the separation of C cooling may not be rapid enough to prevent decomposition of oxoaustenite.

CHEMICAL ABSTRACTS.

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## CHEST (DIAGNOSIS)

**Neurofibroma Arising on the Pericardial Pleura. William L. Keller and George R. Callender. Ann. Surg., October, 1930, XCII, 666.**

A Filipino house servant, a woman of 38 years, complained of pain and tenderness in various joints, stiffness of one knee joint, and swelling and clubbing of the fingers. Roentgenographic examination of the thorax showed a tumor in the left lower chest which moved with the diaphragm. A phrenicotomy was performed and thirteen days later the tumor was removed. The tumor was encapsulated, with numerous vessels in its smooth capsule, and attached to the pericardium by a broad pedicle, 5 cm. in diameter, and to the lower lobe of the left lung by a smaller pedicle 2 cm. in diameter, over the course of the left phrenic nerve. It was irregularly oval in shape, weighed 660 grams, and measured 14 by 11 by 8 centimeters.

Following the operation the osteo-arthropathy demonstrated some improvement. Reproductions of X-ray films of the chest before operation and one and one-half years later, showing no recurrence, are included.

F. B. MANDEVILLE, M.D.

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**Deformation and Displacements of the Hilum in Pulmonary Sclerosis and Pleural Adhesions. Guido Pescatori. La Radiologia Medica, May, 1930, XVII, 509.**

This is a complete and comprehensive study of pulmonary kinematics. The author discusses the interpretation to be given, with dif-

ferent radiographic images of the chest, and illustrates his article with abundant radiographic material. Special emphasis is laid upon the movement of the hilum and its position, since it is considered by the author as the most eloquent factor in the diagnosis of pleural or pulmonary sclerosis.

The article is so detailed that it is impossible to give a complete abstract of it in restricted space.

L. MARINELLI.

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**Syphilis of the Lungs. Karl Herman. Röntgenpraxis, Oct. 15, 1930, II, 916.**

Syphilis of the lungs is a very rare disease and can easily be mistaken for tuberculosis, carcinoma, or chronic pneumonia. Clinically, syphilis of the lungs may present itself in three types: (1) Syphilitic bronchitis; (2) chronic pneumonia; (3) chronic pseudophthisis. The roentgen appearance alone is not diagnostic. The Wassermann reaction and the result of specific therapy assist one in making a definite diagnosis. Two cases are described in detail in which the roentgenologic and clinical examinations and the success of anti-syphilitic treatment made the diagnosis of lung syphilis certain.

H. W. HEFKE, M.D.

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**Further Studies on Cardiac Pulsation in Pneumothorax. Alessandro Vallebona. Archivio di Radiologia, July-October, 1930, VI, 827.**

In this study the author shows that jerky pulsation of the heart is most marked at the end of expiration, and is due to changes in pressure in the pleural cavity and altered relationship between the lungs and heart.

E. T. LEDDY, M.D.

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**A System of Reading X-ray Films for Use in Sanatoria. Duncan McRae. Am. Rev. Tuberc., June, 1930, XXI, 811.**

The system described by the author is the one used in the Manitoba Sanatorium, and he claims it has proven very satisfactory. This, in the main, consists of the use of certain letters, figures, and abbreviations to indicate the presence or absence of certain conditions and their extent: thus *"RD up 2, tied,"* we judge, means that the right diaphragm is elevated above the normal, and fixed. A system of this kind in an institution with a constant staff may work out satisfactorily, but a report of this nature would hardly be satisfactory if sent out to a physician not familiar with the language.

In an X-ray laboratory doing general work for varying groups of physicians, it would hardly prove practical. The fact, however, that it encourages detailed study and systematic reading recommends it.

S. C. BARROW, M.D.

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**Bronchography—the Passive Technic. F. H. Cooley. Journal-Lancet, Aug. 1, 1930, L, 373.**

(*Abstractor's note:*—It is the custom in many places for the physicians to refer patients to radiologists for the introduction of opaque oils into the bronchi preparatory to X-ray examination. Any simplification of the technic will be welcome to radiologists, therefore.)

The use of the passive technic is based on the physiology of swallowing, which is partly voluntary and partly involuntary, the latter dependent upon the former. Sensory anesthesia of the anterior pillars of the fauces will abolish the reflex act, preventing elevation of the larynx and, therefore, opening of the esophageal orifice. Any substance entering the pharynx under such conditions must pass down the larynx.

After cleansing the mouth, the anterior surface of the anterior tonsillar pillars is swabbed with a 10 per cent solution of cocaine until the swallowing reflex is abolished, usually three or four swabbings. Then three or four c.c. of a 3 per cent cocaine solution is given the patient, who is told to lean back, protrude the tongue, lean toward the side to be filled, and breathe naturally. The solution will be aspirated into the lung. Then the faucial pillars are again swabbed, and the patient is given 10 c.c. of iodized oil, which is aspirated into the lung in the same manner as the cocaine solution. After expectoration of sali-

va, another 10 c.c. is introduced. This is an ideal procedure for bronchography.

W. W. WATKINS, M.D.

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**The Hairline in the Roentgenogram of the Lungs. L. Schall and F. Hoffmann. Röntgenpraxis, Nov. 1, 1930, II, 977.**

In good roentgenograms of the lungs, one may occasionally see a very fine line in the right mid-chest, either straight or slightly curved, which is the so-called "hairline." Hotz found this in 6.5 per cent of his cases, Schönfeld in 13.5 per cent, and the authors in 16.1 per cent in 4,508 films. The authors are of the opinion that this fine line represents the interlobar pleura, the presence of which does not necessarily mean an old or recent interlobar pleurisy. It is probable that the normal interlobar pleura may also cast this shadow in certain cases.

H. W. HEFKE, M.D.

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**Roentgenology of the Upper Respiratory Tract. Henry K. Pancoast. Jour. Am. Med. Assn., Nov. 1, 1930, XCV, 1318.**

The upper respiratory tract from the nasopharynx to the carina has recently become a very important field for roentgenologic diagnosis. The most important factor in diagnosis is a careful study of the soft structures during an examination of the neck. This includes fluoroscopic observations of the movements or changes in lumen of the various portions of the tract during respiration, speech, and swallowing, and the making of roentgenograms for records. In all instances the chest should be included, and especially in infants and young children.

Since the beginning of Hay's work the members of the author's staff have realized that the only way of determining accurately the potential dangers of the thymus in infancy is through a study of its effects on the upper respiratory tract and not by an estimation of its dimensions. The technic of examination is explained and discussed.

The author states that practically all of the pathologic conditions presented by the larynx and neuromuscular disturbances show some recognizable phenomena or abnormal appearances, many of which are characteristic.

The study of phonation and the swallowing act is essential in all cases. Both of these functions are described in his essay.

CHARLES G. SUTHERLAND, M.D.

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**The Clinical and Roentgenologic Value of the Lateral Chest. C. H. Warfield. Illinois Med. Jour., December, 1930, LVIII, 461.**

The lateral chest is not used as much as it should be, because of the difficulty in securing uniformly satisfactory results. The technic used is 118 P.K.V., 50 ma., one-half second, at a distance of 7 feet, for the average adult of 150 pounds. The patient stands with the affected side toward the film, crossing the arms in front of him, and, grasping them just above the elbows, places them on the flexed head and neck. Holding tight to the head, he raises his arms and head simultaneously until his body is in the vertical position. This position places the shoulders and scapula posteriorly. As deep a breath as possible is necessary to lessen the exposure. It is very important that the tube be placed seven feet or more from the film since the aorta, for instance, is about five inches from the film.

The author discusses the value of this position in cases of foreign body, abscess, aneurysm, aortitis, aortic arteriosclerosis, and the differential diagnosis of pericardial effusion and acute dilatation of the heart, and believes this to be of great value in pathology of the base of either lung. The enlarged thymus should always be studied in the lateral position for evidence of compression and displacement of the trachea.

C. H. DEWITT, M.D.

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**Subacute and Chronic Pulmonary Infections Commonly Mistaken for Pulmonary Tuberculosis. Hugh J. Morgan, Am. Rev. Tuberc., November, 1930, XXII, 491.**

The writer confines his discussion to three diseases commonly met with, *viz.:* chronic bronchitis, subacute or chronic bronchopneumonia, and bronchiectasis. He states that records from Trudeau Sanatorium (1916-1923)

show that 75 per cent of the cases applying for treatment, found to be non-tuberculous, were cases of chronic bronchitis and chronic bronchopneumonia. No clean-cut differential points are given in the discussion of diagnosis from history and physical signs. Under chronic bronchopneumonia, he says the X-ray findings are points of great diagnostic importance, and under bronchiectasis, that X-ray examinations are diagnostic in the majority of cases.

The great value of the article lies in the signal which it sounds for care and the avoidance of hastily pronouncing the non-tuberculous, tuberculous.

S. C. Barrow, M.D.

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**Fibrin Bodies in Artificial Pneumothorax Cavities or Pleural Mouse. H. V. Morlock and Franklin G. Wood. British Jour. Radiol., November, 1930, III, 515.**

Three cases of fibrin bodies observed in the pleural cavity, following artificial pneumothorax, are reported in some detail. In two of the cases an effusion preceded the appearance of the fibrin body, and in the third an effusion may have previously existed, although this was not definitely proven. The authors believe the theory of formation of fibrin bodies around a nidus of a fibrin flake or particle to be more probable than from the deposition of blood fibrin, following a traumatic hemorrhage of an intercostal artery. One case had been studied over a period of four years and the only change noted was a slight reduction in the size of the body. In most instances, change in position of the fibrin body could be demonstrated, hence the name "pleural mouse."

J. E. Habbe, M.D.

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**Bronchiectasis: An Analysis of 51 Cases. W. W. Priddle. New York St. Jour. Med., Sept. 15, 1930, XXX, 1077.**

Bronchiectasis was diagnosed in 7.1 per cent of all cases in the adult medical wards of the Buffalo City Hospital. Lemon has found that 4 per cent of all children admitted to the Mayo Clinic have bronchiectasis. In the group reported upon, incidence is greatest between 40 and 60 years of age, the onset occurring before the age of 20 in 21.5 per cent. Males were affected 4.1 times as frequently as females. Pulmonary infection in childhood is connected with bronchiectasis in a large percentage of cases. There was wide variation in the type of lesion found in the bronchus and surrounding lung parenchyma. Lesions were usually basal and more frequently on the left.

Roentgenography, as in any chest condition, was a real aid, but only in conjunction with clinical findings. In this series the X-ray department made a positive diagnosis in 64 per cent of the cases from plain films. The absolute diagnosis can be made only by the use of iodized oil injections, which give an accurate picture of the nature and extent of the lesion. This procedure should be used, however, only after other methods have been carefully considered. In 47 cases out of 51, clinical diagnosis was made by the history and physical findings alone.

W. W. Watkins, M.D.

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**Localized Pneumothoraces as a Cause of Annular Shadows in Roentgenograms of the Chest. W. P. Warner. Am. Rev. Tuberc., November, 1930, XXII, 531.**

This article is a complete clinical history, with X-ray findings and postmortem study, of a patient whose chest showed two large annular shadows, diagnosed by the radiologist as localized pneumothoraces, and so proven at postmortem. The author states that this is the only case found in the literature in which annular shadows resembling cavities, diagnosed as localized pneumothoraces, have been proven at autopsy. A very thorough review of the opinions, theories, and findings of the many who have written on the subject is given, making a valuable reference table for those interested in the question, "What are annular shadows?" The study of this case unfortunately does not determine the content of these cavities, or disprove a positive air connection with the lung, owing to accompanying pathology.

The report is a valuable one and should be studied carefully, along with the references,

by all roentgenologists engaged in chest examinations.

S. C. Barrow, M.D.

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**The Normal and Pathologic Interlobar Fissure in the Roentgenogram. I. G. Brdiczka and G. Wolf. Röntgenpraxis, Nov. 15, 1930, II, 1014.**

The normal interlobar pleura may be demonstrated on an X-ray film. It presents itself as a very thin hair-line caused, in most cases, by the folding of pleura over the edge of the lung rather than by the projection of the interlobar pleura itself. The fine line is found in about 40 per cent of normal cases. Moderate thickening of the line indicates an old pleuritic process while a markedly thickened line proves the presence of interlobar adhesions.

H. W. Hefke, M.D.

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**"Pleural Rings" or Annular Shadows in the Lungs. William Mitchell. British Jour. Radiol., October, 1930, III, 446.**

The author at once excludes ordinary tuberculous cavities and discusses those remaining annular shadows so puzzling to most radiologists. He prefers the term "air cysts," and believes that they almost always represent air spaces within the lung, produced by perforation of a small bronchus, with escape of air into the connective tissues in the form of a single bubble of air. If there is a ball-valve action between the bronchus and the air space, allowing ingress only of air into the "air cyst," then there may be a rapid increase in the size of the annular shadow. If, on the other hand, the point of perforation is healed over, then the imprisoned air may be quickly absorbed, with rapid decrease in size of the shadow. The author believes these air cyst shadows to be pathognomonic of tuberculosis, even in the absence of pulmonary fibrosis.

J. E. Habbe, M.D.

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**X-ray Diagnosis. Kenneth D. A. Allen. Colorado Med., November, 1930, XXVII, 424.**

This short paper is part of a symposium on atelectasis, and describes the diagnostic rôle played by the X-ray in post-operative chest complications, with special reference to atelectasis. The X-ray plays its part in the following: (1) determining the behavior of the diaphragm, by films taken in expiration or inspiration,—or by fluoroscopy; (2) by determining the X-ray signs of atelectasis, and the type of lesion. The X-ray signs of atelectasis are *(a)* the displacement of the heart, mediastinum, and sometimes the tracheal shadows toward the affected side; *(b)* high diaphragm on the affected side; *(c)* decreased radiolucence of the atelectatic area; *(d)* increased radiolucence on the opposite side; *(e)* narrowing of the rib spaces; *(f)* affected lung curves toward the spine, while the opposite lung curves away from the spine; *(g)* heart moves toward the affected side in inspiration; *(h)* restriction of the diaphragm on the affected side. Atelectasis may be massive or localized. The localized type is not as clear-cut and requires close co-operation between the members of a medical team to make an accurate diagnosis.

W. W. Watkins, M.D.

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**Our Growing Dependence on the X-ray. Editorial. Canadian Med. Assn. Jour., October, 1930, XXIII, 563.**

This editorial sums up rather well the changing attitude of the profession in general toward the radiologist. Quoting a speaker at the British Medical Society meeting in Australia, who, in discussing the value of radiology in the diagnosis of diseases of the chest, referred to the "physician with a guarded admiration for the radiologist, and the radiologist with no admiration for the physician," the Editor indicates that, while this is not the average viewpoint, it does reflect to some extent the stages through which medical opinion has passed or is passing, with regard to the place of the X-ray in the diagnosis of chest disease.

The Editor quotes from such "guarded admirers" of the radiologist as Cabot in his "Physical Diagnosis," and Morriston Davies and Sir Thomas Horder. Cabot is quoted as follows, "In incipient tuberculosis the X-ray as often leads us wrong, as right." Davies

says, "Radiology has helped to confuse us"; while Horder refers to the "bastard pathology" of the radiologist.

But the radiologist has his turn. Dr. Gerald Webb says, "Roentgen examination is the only method available for detecting early pulmonary tuberculosis." Dr. L. H. Fales is quoted: "The roentgen ray is the most important means of determining the existing pathological condition of the lungs."

With this latter viewpoint the Editor is in accord when he writes, "Where is the hospital which cannot show radiographs of pulmonary cavities whose presence had at best been only hinted at in the physical examination, but not diagnosed; or of foreign objects in the lung whose manifestations had for years been translated as those of tuberculosis?"

The Editor sums up the proper relation between the radiologist and the clinician as one of "co-operation." Each is supreme in his field, and the work of each should be the complement of that of the other, with resulting fixation of diagnosis. While the X-ray often provides information with an accuracy to which the physical examination cannot attain, it must not be depended on as a short-cut. It is an added source of information, which may confirm, correct, or amplify a diagnosis, or may fail to do any of these things.

L. J. CARTER, M.D.

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**Early X-ray—Early Diagnosis. William B. Davidson. New England Jour. Med., Oct. 30, 1930, CCIII, 860.**

Without early X-ray, the diagnosis of an early lesion of tuberculosis cannot be made. Especially is the early X-ray examination important in the childhood type of tuberculosis, not forgetting that the adult can have the childhood type. In a differential diagnosis the X-ray examination is indispensable. The author's technic, which is not essentially different from the usual technic, is described. He sees no advantage in extra-rapid exposure. Stereoscopic films have not been found to be more valuable than flat films, although the oblique or lateral views of the chest are recommended. Fluoroscopic examination should be used as an adjunct. The classification of McPhedran is followed in the childhood type.

(*Abstractor's note:* It is refreshing to find a writer who is not afraid to say that the flat film is usually as useful as the stereoscopic film. It is believed that many radiologists have this view, and practise it, though the common expression, "excellent stereoscopic chest films are essential," bluffs them.)

W. W. WATKINS, M.D.

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**Diagnosis and Treatment of Non-tuberculous Suppurative Lung Lesions. James H. Stygall. Jour. Indiana St. Med. Assn., November, 1930, XXIII, 526.**

Our conception of lung suppurations has changed considerably in the last fifteen or twenty years, principally because of the use of the X-ray, lipiodol, and the bronchoscope. There are three common types of lung suppuration—and they may be co-existent—namely, bronchiectasis, empyema with bronchial fistula, and lung abscess. Bronchiectasis is frequently undiagnosed, and unaided X-ray examination may be of little value, but by outlining the bronchial tree with lipiodol, the diagnosis is quickly made by the use of the X-ray film or under the fluoroscope. In lung abscess the physical signs are often negligible and at best depend on the proximity of the abscess to the periphery. The physical examination cannot be depended on entirely and should always be supplemented by the X-ray.

W. W. WATKINS, M.D.

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**The Limitations of the Roentgenologic Diagnosis of Diseases of the Thorax. Ernst Lachmann. Röntgenpraxis, Sept. 1, 1930, II, 769.**

This article endeavors to show how seldom the roentgenologic symptoms of a chest disease are absolutely pathognomonic, and in which cases the anatomical changes are not demonstrable by means of the roentgen ray. The author's own experience and the opinion of other authors quoted from the literature make a very instructive essay on the limitations of the roentgenologic chest diagnosis. Although the roentgen examination is prob-

ably the most valuable means of diagnosis to the clinician, it should be closely associated with other diagnostic methods.

H. W. HEFKE, M.D.

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**Silicosis. T. H. Belt. Canadian Med. Assn. Jour., December, 1930, XXIII, 802.**

Silicosis is a purely industrial disease, affecting the lungs of persons whose occupations expose them over long periods to the dust of hard rock. The disease has received a great deal of attention in Africa, where, for many years, it has been a serious problem in the mining industries. Only within the past six years has the disease received serious attention in Canada, but in the Province of Ontario it is now recognized as a compensable form of disability.

Silicosis is characterized by extreme chronicity. It runs entirely to fibrosis of the lungs, and, while not fatal in itself, renders the victim particularly vulnerable to pulmonary infections. The majority of sufferers from silicosis eventually develop tuberculosis of the lungs, and the combination almost invariably proves fatal. In the presence of silica, the tuberculous infection runs wild, but the reason for this is unknown. Numerous theories of an explanatory nature are enumerated by the author.

L. J. CARTER, M.D.

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**Mediastinal Pleural Effusion: A Roentgenologic Study. Jacob Sagel and Leo G. Rigler. Am. Jour. Roentgenol. and Rad. Ther., September, 1930, XXIV, 225.**

The author states that mediastinal effusion is not so infrequent as formerly believed, and is often overlooked clinically, due to difficulty in diagnosis. It is generally encapsulated but may rarely occur as a free pleural effusion and extend secondarily into the lateral pleural cavity. Anatomically, the mediastinal pleural cavity is divided into two parts, an anterior and a posterior, which are separated by the pulmonary ligament. Considering location there are four possible kinds of mediastinal pleural effusion: (1) that in the anterior space on one side; (2) that in the posterior space on one side; (3) the bilateral type, and (4) the so-called "saddle type." Etiologically there are two chief types: (1) the serous type, which is generally associated with pulmonary tuberculosis, and (2) the purulent type, which is usually pneumococcic or, rarely, streptococcic in origin. The purulent type generally follows pneumonia and should be sought for when prompt return to normal does not occur, after the usual period of illness.

As to the technic of examination, both roentgenoscopic and roentgenographic methods are used. The characteristic roentgen finding is a triangular shadow on either side of, and continuous with, the median shadow, from which it cannot be separated regardless of the position in which the patient is placed. It may displace the adjacent part of the lung or heart, usually the latter, to the opposite side. No cardiac pulsation is visible in this abnormal shadow. In some cases of posterior mediastinal involvement typical symptoms are produced, due to pressure on structures in the mediastinum. In the series of 15 cases cited, the posterior type predominated, recovery occurring in all but one case. Six were empyemas in the posterior space and were proved by thoracentesis. The article is well illustrated.

J. E. HABBE, M.D.

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## CHEST (GENERAL)

**Bronchomycosis: Report of Two Cases. William Royal Stokes, Edgar F. Kiser, and William H. Smith. Jour. Am. Med. Assn., July 5, 1930, XCV, 14.**

The etiologic relationship of certain forms of budding fungi included under the general name of *Endomyces* has been described by Castellani in calling attention to chronic bronchial infections in which tubercle bacilli in the sputum were never demonstrated. Such sputum, however, constantly contained various yeast-like organisms, which he divided into several groups.

Two cases are reported in which extensive chronic interstitial fibrosis existed and tubercle bacilli were not demonstrated in the sputum. A form of yeast was obtained in both,

which in morphology and cultural characteristics resembled *Monilia albicans* as given in Castellani's table, with one exception. This organism, injected into white rats, produced a pathologic condition similar to that produced by the tubercle bacillus, but these lesions did not show any tendency to spread through the internal viscera, and remained either as local processes or as scattered nodules on the serous surfaces.

Other observations showed this single exception to Castellani's grouping, and seemed to classify the organism as *Monilia albicans*. The isolation of these fungi from the sputum is, of course, no proof that they have produced the clinical conditions described. The repeated absence of tubercle bacilli and of other organisms suggests an etiologic relationship.

CHARLES G. SUTHERLAND, M.D.

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**Post-operative Pulmonary Hypoventilation. Richard H. Overholt. Jour. Am. Med. Assn., Nov. 15, 1930, XCV, 1484.**

Variations from the normal and physiologic conditions below the diaphragm, which occur after laparotomy and their effect on the position and activity of the diaphragm, indicate that pulmonary hypoventilation exists for a variable time after operation. A routine study of the chests of patients before and after upper abdominal operations showed a 75 per cent diminution of chest expansion after operation. The thoracic circumference became greater after operation. The observations indicated that free, normal respiratory activity is interfered with after the abdomen has been opened. Roentgenograms showed the superior-inferior diameter of the thorax to be greatly diminished in the post-operative films because of a marked elevation of the diaphragm. Fluoroscopic observation showed a 33 to 50 per cent reduction in diaphragmatic excursion after operation. Anything approaching physiologic aeration of a greater portion of the lower lobes during inspiration is impossible because of the position of the diaphragm and its diminished excursion. There would seem to be a definite mechanical disturbance to respiration as a consequence of the admission of air into the peritoneal cavity. A study of the vital capacity of 218 patients was made before and after the performance of abdominal operations. Following operations on the upper abdomen, the vital capacity was reduced 64 per cent of the pre-operative or normal value. Following lower abdominal operations the average vital capacity was reduced 40 per cent of the normal value. Approximately a 15 per cent reduction in the vital capacity could be attributed to a tightly fitting abdominal binder applied post-operatively. When an ordinary surgical dressing of gauze and adhesive tape was applied, very little change in the vital capacity was noted.

The effect of pain in limiting respiration after operation was investigated by studying patients still under the influence of spinal anesthesia. From this study it would seem probable that a mechanical interference with respiration occurs at the time the abdomen is opened. This is confirmed by the experimental evidence. That pain is also an important factor cannot be denied. In cases in which symptoms of hypoventilation are very evident, treatments with carbon dioxide are given at regular intervals for a period of three or four days, post-operatively. Frequent turning and deep-breathing exercises should be resorted to early in every case.

The author suggests a post-operative procedure of having the anesthetist give carbon dioxide inhalations under positive pressure, as the abdomen is closed. Air in the abdominal cavity is displaced by a physiological solution of sodium chloride, which is removed by suction as the peritoneum is finally closed. A tightly fitting, many-tailed binder should not be used when there is pulmonary embarrassment. The free post-operative use of morphine should be encouraged.

C. G. SUTHERLAND, M.D.

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**Dust and Pulmonary Disease. Albert E. Russell. Jour. Am. Med. Assn., Dec. 6, 1930, XCV, 1714.**

The advances which have been made in all branches of industrial medicine have helped to center attention on dust and its effect on the health, as the number of the workers in dusty

trades is larger than that of any other group exposed to a single industrial hazard. Workers in dusty trades have an excessive death rate from tuberculosis, as well as from other respiratory diseases. Studies have covered the cement industry, representing calcium dust; silver polishing, representing metal dust; the granite industry, representing silica dust; the coal industry, representing carbon dust; the cotton industry, representing vegetable dust, and street sweeping, representing municipal dust.

Originally, the dangerous properties of dust were supposed to be dependent on physical characteristics. These may be a factor in producing chronic pathologic conditions in the upper respiratory passages and the bronchi. Generally speaking, dusts are more injurious as their chemical composition differs from that of the human body or from the elements of which the body is normally composed. In experimental work, silica produced a considerable degree of necrosis. It is well known that tubercle bacilli grow well in a medium rich in colloidal silica. The excessive amount of other respiratory diseases can be accounted for by the lowered local resistance caused by the presence of dust, the irritation produced by mechanical injury, and the diminution of the local blood supply by fibrosis. The concentration of dust and the size of particles are factors. The rock from which the dust is derived varies in the known dangerous element. The length of exposure to dust is evidently a great factor in the production of disability. The effects produced by the inhalation of dust are interestingly reviewed under the headings of morbidity, physical condition, and mortality.

C. G. SUTHERLAND, M.D.

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## CHEST (THERAPY)

**The Effect of Phrenicectomy on Pulmonary Cavitation. Walter I. Werner and E. J. O'Brien. Am. Jour. Roentgenol. and Rad. Ther., December, 1930, XXIV, 626.**

The authors studied 200 cases of pulmonary tuberculosis, with cavities 3 centimeters or larger in diameter. One hundred cases received routine rest cure. In 75 of the other group, phrenicectomy was done, while it was performed as an accessory to artificial pneumothorax in 25 cases. In the group of 100 cases which received no surgical treatment there were 66 with oval cavities and 34 with fibrotic-walled cavities. A tabulation shows the fate of the cavities in this group, while a second tabulation shows results of 100 surgically (phrenicectomy) treated cases, and still another presents a comparative summary of both. Three case reports are presented, with roentgen illustrations. The authors believe that since the occurrence of excavations in pulmonary tuberculosis points to an unfavorable prognosis, the figures presented of the results following phrenicectomy on cavitation, have been very encouraging.

J. E. HABBE, M.D.

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**Lung Abscesses: A Clinical Study, with Especial Emphasis on Conservative Treatment. H. I. Spector. Jour. Am. Med. Assn., Sept. 13, 1930, XCV, 789.**

A review of a vast literature on lung abscess leaves one with a great deal of confusion. The existing pessimism regarding expectant treatment of lung abscess is unjustifiable. Lung abscesses are rarely sequalæ to lobar pneumonia and are probably more common following bronchopneumonia. Operations in the upper respiratory tract are increasingly gaining recognition as a causative factor of lung abscess. It may be primary, the clinical and experimental evidence suggesting a primary pneumonia followed by abscess formation.

The mode of entrance into the lung of the causative organisms divides opinion between the bronchogenic or aspiration, and hematogenous or embolic theories. A combination of the two may explain the pathogenesis of a certain group of post-operative abscesses of the lung. Organisms may also enter the lung by direct extension from an adjacent suppurative process, through the diaphragm, or following injury to the chest or intrathoracic organs. Chronic infections in the upper respiratory tract, the retention in the lungs of cer-

tain anaërobes ordinarily found in the oral cavity, and pre-existing bronchopulmonary pathologic change—each plays a rôle in the production and in the chronicity of abscesses. Anything tending to abolish the cough reflex during anesthesia, or to increase the cough after anesthesia, may be instrumental in the production and in the chronicity of abscesses. Pathologically, abscesses may be bronchiectatic, extra-bronchial, or suppurative pneumonitis. Acute and chronic types are recognized, single, bilateral, or multiple. They may occur in the hilar region, in the center or in the periphery of the lung. Roentgenologically, in the early stage the abscess is frequently seen as an irregular consolidation not characteristic in appearance. After rupture, if the cavity is partially filled, a fluid level can be seen, with a rarefied area above. An extensive zone of congestion is frequently seen around the abscess.

Conservative treatment—absolute bed-rest, diet, and postural drainage—is gradually making an impression. If the patients did not show improvement within a reasonable length of time, in selected cases, pneumothorax was attempted. More radical surgery was resorted to if this was not successful. Bronchoscopy, transfusions, and arsphenamine were used twice each in different cases, and as a last measure in the hopeless cases. The author was not inclined to use them in cases which were constantly improving under expectant treatment alone.

CHARLES G. SUTHERLAND, M.D.

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**Roentgenologic Studies of the Pulmonary Pictures in Influenza Patients during the Epidemic in 1928-29. Bruno Misske and Adolf Sylla. Fortschr. a. d. Geb. d. Röntgenstr., July, 1930, XLII, 4.**

The influenza bacillus of Pfeiffer is regarded as the most likely etiological factor of the influenza infections, but what conditions of soil and environment lead to its activated virulence and to the production of epidemics, are not mentioned. The well known roentgenologic pictures of the catarrhal and pneumonic forms, with all their variations and complications, are illustrated in a number of cases. Non-resolved pneumonias and chronic empyemata are frequently treated with roentgen irradiation, besides other methods. The impression, sometimes given, of beneficial influence of such treatment does not always prove convincing.

Bronchoscopic aspiration and drainage apparently would not seem to be practised to any appreciable extent by the authors.

HANS A. JARRE, M.D.

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**Internal Drainage: Its Application in Pulmonary Suppuration. William B. Faulkner. Jour. Am. Med. Assn., Nov. 1, 1930, XCV, 1325.**

Intrabronchial drainage is of two types: "external," in which a bronchus empties itself by cough and expectoration, and "internal," in which a bronchus empties itself inadequately, the pus spilling about from place to place within the lung. This spilling, or internal drainage, is a definite entity in pulmonary suppurations, and an understanding of it is important in the diagnosis and treatment of this condition. The occurrence of internal drainage has been substantiated by iodized-oil studies and bronchoscopic examinations. Physical examination, plain roentgenograms, operative studies, and autopsy observations further support the theories of internal drainage. The mechanism of the internal drainage is discussed in detail, with suggestions for the practical application of the principles involved. The application of these principles has enabled the author to localize more accurately the site of pulmonary abscesses, to lessen the number of patients requiring operation, to lower the operative risk, and to increase the percentage of cures.

C. G. SUTHERLAND, M.D.

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**Observations on Post-operative Pulmonary Atelectasis: Consideration of Some Factors in its Etiology, Prevention, and Treatment. Harold Brunn and Selling Brill. Ann. Surg., November, 1930, XCII, 801.**

Atelectasis, according to the authors, is the predominating post-operative pulmonary com-

plication. It may be of any extent, from involvement of very small portions of pulmonary parenchyma to a whole lung or both lungs. After reviewing a mass of literature of the past hundred years, including the papers by Coryllos and Birnbaum, Bowen, Van Allen and many others, the authors conclude that bronchial obstruction is the most important single factor in the production of atelectasis, and that with the relief of the obstruction the lung re-inflates. The pre-operative, operative, and post-operative factors, which may aid in the formation of this lesion, are discussed in detail.

Bronchoscopically, four types of findings in atelectasis were noted: (1) the presence of an obstructing plug or characteristic tenacious sputum; (2) a profuse purulent secretion; (3) no secretion in the bronchi; (4) one unusual case of local bronchial edema. The use of bronchoscopic aspiration in prophylaxis as well as in treatment was suggested, and the importance of applying the principles of intrabronchial drainage in the posture of the patient, in combination with $CO_2$ inhalations, was discussed.

The uncomplicated post-operative lesion presents an excellent prognosis. All post-operative pulmonary complications, excluding embolic types, are not believed to be of the same nature. From clinical, X-ray, and bronchoscopic observations, the authors believe that there seems to be one type more like lobar pneumonia, and they discuss a case illustrated with roentgenograms. A large and most excellent bibliography is attached.

F. B. Mandeville, M.D.

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## CONTRAST MEDIA

**A New Method of Blood Vessel Visualization (Arteriography, Veinography, Angiography) *in Vivo*. Makoto Saito, Kazunori Kamikawa, and H. Yanagizawa. Am. Jour. Surg., November, 1930, X, 225.**

The authors review the work that has been done in this line up to the present time, and describe their solution as a fine emulsion of iodized oil, originated by Professor Hattori of the Tokio Imperial University. To prepare it protalbinacid was used. The preparation is a yellowish-white, slightly alkaline, isotonic emulsion. No hemolytic or rapid hemostatic action *in vivo* or *in vitro* was found. Each oil globule is smaller than a blood corpuscle.

This new contrast medium, called L'ombre, has given clear, satisfactory roentgenographic films. It has also been used in pyelography, myelography, and visualization of fistulæ and articular cavities. For pyelography it is especially valuable because of the low viscosity, the absence of irritation to the mucous membranes, and the strong radio-activity which insures very clear shadows.

The original article should be consulted for the technic in using this solution and for its preparation.

Howard P. Doub, M.D.

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**Roentgen Diagnosis of Synovial Adhesions. Editorial. Jour. Am. Med. Assn., Dec. 6, 1930, XCV, 1749.**

Following fifteen years of patient experimentation, another unusual chemical adjunct to roentgen diagnosis seems to be available. With this new aid, altered permeability of synovial membranes can be determined, and accurate pictures secured of synovial adhesions. Demonstrations of abnormal synovial permeabilities were made about sixteen years ago by Dr. Henry Keller, orthopedic surgeon of the Neurological Hospital, New York, who injected easily diffusible dyes into joint cavities, and followed their subsequent excretion by the kidneys. Disodium salt of tetraiodo-orthosulphobenzoic acid is a non-toxic chemical substance readily excreted by the kidney, and of sufficient density to cast a distinct shadow on the X-ray film. This sodium salt is odorless, tasteless, and readily soluble in water, an 11.3 per cent solution being isotonic with human blood. The isotonic solution is non-irritating when instilled into the conjunctival sac of the human eye. Injection into laboratory animals does not cause local irritation. Intravenous injections are well borne by animals and the injected drug is rapidly excreted by the kidneys. Kidney function is

not impaired. With ordinary concentrations, no depression is demonstrable with isolated smooth muscles. Albino rats, previously trained in a circular maze, do not show impairment of memory on administration of the new drug or alteration in neuromuscular control. Injected into joint cavities of dogs, the new compound gives sharply defined X-ray shadows of joint cavities.

C. G. SUTHERLAND, M.D.

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**Uroselectan in the Demonstration of Blood Vessels (Vasography) and Especially of Varicosities. Max Ratschow. Fortschr. a. d. Geb. d. Röntgenstr., July, 1930, XLII, 37.**

For successful roentgenologic demonstration of the blood vessels, four demands have to be met by the contrast medium to be employed: It must not harm the interna of the vessels, nor produce disturbance of circulation or affection of the organism, but it should be sufficiently radiopaque in high dilution. All opaque oils produce fatty embolism and bronchopneumonia. Strontium bromate produces thrombosis of vessels.

Uroselectan proved to be a very satisfactory contrast medium, and, as demonstrated in a series of reproductions, permitted of excellent visualization of veins and especially of varicosities.

HANS A. JARRE, M.D.

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**Uterosalpingography in General Practice: with Case Reports. J. Martin Johnson. Wisconsin Med. Jour., September, 1930, XXIX, 497.**

The author's procedure is preliminary and operative. In the preliminary stage, a careful history is taken and complete physical examination made; this latter includes determination of the patency of the cervix, and dilatation of the canal is made. Following this, the patient may be taken or sent to the X-ray laboratory, the co-operation of an experienced roentgenologist being deemed essential. With the patient on a table equipped with a Bucky diaphragm, by means of the Pressometer, lipiodol is injected. The fluoroscope may be used to follow the injection, if desired. After four or five c.c. have been injected, the first film is made and the patient is allowed to flex or extend her legs, though without disturbing the nozzle in the uterus. After developing the first film and noting the amount of oil injected, a second injection is made. A total of 10 c.c. should be sufficient in the majority of cases. This procedure definitely outlines the uterus and tubes, and localizes the point of obstruction if the tubes are not patent. The procedure is harmless and may be readily accomplished by the physician who adheres to fundamental principles.

W. W. WATKINS, M.D.

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## DIAPHRAGMATIC HERNIA (DIAGNOSIS)

**Progress in the Roentgenologic Diagnosis of Diaphragmatic Hernia. Alexander B. Moore and B. R. Kirklin. Jour. Am. Med. Assn., Dec. 27, 1930, XCV, 1966.**

A vast and growing literature on diaphragmatic hernia attests the keen interest in this condition. From experience it is evident that diaphragmatic hernia is not merely a pathologic oddity, but a lesion which should be taken into practical account and given higher rank among the possibilities to be canvassed at examination. Recent publications emphasize the congenital factor, whereas in earlier days the acquired form, principally that resulting from violent crushing injury, was stressed. An increase of intra-abdominal pressure is often doubtless the cause of hernia, congenital gaping of the hiatus esophageus or other foramina, or developmental weaknesses in other portions of the diaphragm, usually being a significant predisposing element. An interesting variety is that in which the esophagus is congenitally shortened. When the entire stomach lies above a normally developed diaphragm, some prefer the designation "thoracic stomach," and classify it apart from the hernias.

Case reports, over the last five years, deal with traumatic hernias through breaches in various parts of the diaphragm, parasternal and other hernias, congenital or acquired, all differing in details but fundamentally alike in their diagnostic problems. The aggregate of

new reports tends to confirm the accepted fact that the stomach is most frequently implicated in the hernia and is followed by the colon, small bowel, omentum, spleen, pancreas, and liver, singly or in varying combinations. Of all the cases now on record, the vast majority were revealed by the roentgen ray. Obviously, then, the roentgenologist has a virtually clear field and a proportionate responsibility for this diagnosis. The chief obstacle to the diagnosis of diaphragmatic hernia is the neglect to look for it. The examiner is often obliged not only to consider all details with extraordinary care, but also to resort to special technics. Unless the hernia is extremely small or is reduced spontaneously at the moment, thoracic changes will be evident in the chest roentgenogram. Any deviation in the terminal course of the esophagus or retarded entrance of the barium into the stomach, should at least suggest the thought of hernia. Distortion of the stomach in hernia of any type is variable in degree and configuration. Rarely, as in a congenital absence of the left diaphragmatic arch or in a gross traumatic hernia, little distortion occurs. Most often, however, the stomach is only partially herniated and hour-glass deformity results rather constantly. Since the fundamental distinguishing mark of hernia is the supradiaphragmatic situation of abdominal organs it is necessary, although sometimes difficult, to trace the outline of the arches. Often the arch is irregular, or sinuous, or angulated at the point of rupture, or the margins of the breach may form a visible collar. Respiratory movements of the arch may be normal, diminished, absent, or reversed, depending on the size of the hernia and the extent of fixation by adhesions. Completing the picture are displacement of the heart, if the hernia is large, and shading of the lung, in proportion to the amount of compression.

Ordinary technic is often inadequate and must be supplemented by special methods. The advantages of the lateral view have been dwelt upon. The prone position, with manual pressure on the abdomen, has revealed hernias not demonstrable otherwise. Deep inspiration by the patient, or bending over, while in the standing position, or strong manual pressure over the abdomen may cause re-appearance of a spontaneously reduced hernia. Examination of the stomach for diaphragmatic hernia is not decisive unless both the erect and recumbent postures are employed, and careful search, by the special methods outlined, is made. Diaphragmatic hernia cannot be absolutely excluded without an examination of the colon with the barium enema. Serial observations of the ingested opaque meal may be advantageous or necessary in establishing the diagnosis of the rare cases in which the small bowel alone is implicated. Cardio-esophageal relaxation, characterized by dilatation of the epicardia and ready reflux of the barium into the esophagus, might be confounded with hernia. Eventration is perhaps the most deceptive simulant of hernia. In eventration, the upper level of the barium in the stomach always coincides with the esophageal opening when the patient is erect, whereas, in hernia, the upper level of the gastric content is likely to be above the plane of the esophageal aperture.

CHARLES G. SUTHERLAND, M.D.

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**A Very Large Diaphragmatic Hernia. P. Eichler. Röntgenpraxis, Aug. 1, 1930, II, 712.**

A very large diaphragmatic post-traumatic hernia was found in a patient in whom the stomach and colon almost filled the entire left chest, reaching to the level of the clavicle. The examination of the chest pointed to a seropneumothorax, and only during the examination of the stomach, by means of a barium meal, could the exact diagnosis be made.

H. W. HEFKE, M.D.

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## DOSAGE

**The Effect of Graded Doses of Roentgen Rays on the Mitosis in *Vicia faba equina*. O. Jüngling and H. Langendorff. Strahlentherapie, 1930, XXXVIII, 1.**

The authors studied the mitosis in roots of *Vicia faba equina* under normal conditions. The curves, plotted with the number of mitoses as ordinate and the time as abscissa, showed a certain rhythm. Exposure to roent-

gen rays in doses of 40, 50, 175, 420, and 550 r changed the curves materially. Small doses which did not produce macroscopic nor microscopic changes accelerated the course of the mitosis. Large doses producing definite injuries caused the aforementioned change in the slope and shape of the mitotic curves, as compared with the untreated controls. The principal effect consisted of an increase of the time between two mitotic cycles. For details of the changes a study of the curves is recommended.

ERNST A. POHLE, M.D., Ph.D.

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**A Contribution to Dosimetry with the Sabouraud-Noiré Tablet. Karl Hoede. Strahlentherapie, 1930, XXXVIII, 173.**

The author compared the Sabouraud-Noiré Tablet at potentials of 75 K.V., and 120 K.V., unfiltered, 0.5, 1.0, and 4.0 mm. Al, with a Hammer dosimeter. He found that, in addition to the sources of error demonstrated by previous investigators, there is to be added the absorption by the tablet holder. Depending on the penetration of the radiation, this error may amount to as high as 50 per cent.

ERNST A. POHLE, M.D., Ph.D.

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**The Necessity of Exact Dosage Data in Grenz-ray Therapy. O. Gfrörer and Heinz Berger. Strahlentherapie, 1930, XXXVIII, 184.**

Emphasis is laid upon the fact that the half value layer is not a good quality factor in Grenz-ray therapy. It is essential to indicate the peak kilovoltage, the tube current, the window-to-skin distance, and the output in r-units.

ERNST A. POHLE, M.D., Ph.D.

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**A Biological Calibration of an X-ray Dosimeter. Charles Packard. Jour. Cancer Research, March, 1930, XIV, 134.**

The author calibrated a Victoreen dosimeter, 1928 model, by a biological method. The eggs of the *Drosophila* were radiated and the proportion which hatched, following radiation, was determined. It has been found that when these eggs are subjected to a radiation of a definite number of r-units, a certain percentage hatch. This is independent of the quality or wave length of the X-radiation employed. A curve was obtained showing the percentage of eggs hatching after various doses measured in r-units by a large, open ionization chamber. This curve is not accurate for very small or very large doses. The dosimeter was tested and calibrated against the curve at 60, 100, 150, and 200 kilovolts. The first three were obtained on a Wappler Diex (thermionic rectification). The test with 200 K.V. was made with a mechanically rectified outfit.

The author found that the dosimeter records the dosages correctly, according to this method, when the voltages range from 100 to 200 kilovolts. Under 100 K.V., the full intensity was not registered, being about 13 per cent too low at 60 kilovolts.

JOHN R. CARTY, M.D.

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**The Reproductivity of the Roentgen Dose Unit. Hermann Behnken and Robert Jaeger. Strahlentherapie, 1930, XXXVI, 778.**

Reisner and Neeff have published the results of measurements (*Strahlentherapie*, XXXIV, 313) showing that apparently the calibrations of various ionization instruments in r-units do not agree well. The authors discuss this paper in detail and offer material demonstrating the fact that the r-unit is possible of reproduction within close limits if the measurements are conducted properly.

ERNST A. POHLE, M.D., Ph.D.

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## FOREIGN BODIES

**Observation in Fifty Cases of Foreign Bodies in Air and Food Passages. E. G. Gill. Virginia Med. Monthly, November, 1930, LVII, 516.**

Forty-seven cases gave a history of having aspirated or swallowed a foreign body. Three cases did not have such a history. One of these had been treated for cough, pneumonia, and empyema before the X-ray showed a mattress tack in the right main bronchus. The second baby had been treated for five weeks for "colic" before the X-ray examination showed a large wire ring in the esopha-

gus. The third was a child, three years old, who was treated for six weeks for cough, pneumonia, and asthma, before the X-ray showed a carpet tack in the right main bronchus.

When a definite history of choking or coughing is given by the parents of a child, following eating or playing with objects, organic or inorganic, the case should be considered one of a foreign body until proven otherwise by every diagnostic method at our command.

W. W. WATKINS, M.D.

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**A Molar Tooth in the Left Lower Bronchus. David H. Ballon. Canadian Med. Assn. Jour., December, 1930, XXIII, 821.**

This is a case report of a patient who had seven teeth extracted under general anesthesia. On coming out of the anesthetic he coughed spasmodically and told the dentist he had swallowed something, because he felt a tightness in the chest. Two days later he became very ill with symptoms of lung abscess. The X-ray examination showed a tooth in the left lung. Under gas and ether anesthesia the tooth was removed. Recovery was uneventful.

L. J. CARTER, M.D.

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**Missed Intra-ocular Foreign Bodies: Report of Cases. Barton J. Powell. California and Western Med., October, 1930, XXXIII, 733.**

After discussing foreign bodies in the eye in general and the tolerance of the eye to many of these, the author reports several cases in which foreign bodies were present for a number of weeks.

The author summarizes as follows: "There should be frequent use of the magnet and X-ray, not only to detect the presence of a foreign body, but also as a safeguard against probable charges of malpractice and neglect. And, lastly, make intelligent use of that most valuable localization apparatus, perfected by that grand old master, the late William M. Sweet."

F. B. SHELDON, M.D.

## GALL BLADDER (NORMAL AND PATHOLOGICAL)

**Cholecystitis and Cholecystography. Hugh Smith. Southern Med. Jour., October, 1930, XXIII, 929.**

This author reports his experience in a study of 150 patients by the use of dye intravenously. He first used the dye by the oral method, with tablets and capsules, but the results were so unsatisfactory that the intravenous technic was adopted, and since the improvements in oral technic he has not seen fit to return to the former method. Of the 150 patients, 94 were considered as pathological. Fifty have been operated upon, and a diagnosis was confirmed in 48, so that the preoperative diagnosis has been confirmed in 96 per cent of the cases. The two errors in diagnosis were both found to have duodenal ulcers, and the failure of the gall bladders to empty is believed to have been due to pylorospasm, with prolonged gastric retention of the fat meals. The dye is given at the office at 9 A. M., and films are made at five hours and again at eight hours, with a fatty meal between.

W. W. WATKINS, M.D.

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**Cholecystography: An Analysis after Six and One-half Years' Application. Sherwood Moore. Jour. Am. Med. Assn., Dec. 27, 1930, XCV, 1957.**

The underlying physiologic and radiologic principles of cholecystography have altered little since 1923. There have been certain changes in views or detail of methods and other points. The author discusses these and epitomizes the sum of the experience of himself and his coworkers.

Phentetiothalein sodium-N.N.R. (phenoltetraiodophthalein sodium) is preferred. In addition to being an effective test of liver function, this dye is less toxic than others. It produces a more desirable cholecystogram, with a smaller quantity of dye. The use of substances other than the halogenated phenolphthaleins for visualizing the gall bladder have not proved practical in their hands. In general, whatever the dye employed in cholecystography, accuracy demands that it be

given intravenously, for a known quantity of the substance must reach the circulation if the resultant gall-bladder image is to be exactly evaluated. The routine of administration is given in detail. Oral administration, in their hands, has been employed for diagnostic purposes only in special cases, in which the symptoms are insufficient to warrant the intravenous procedure, or occasionally in an obese subject when there is difficulty in finding a vein suitable for puncture. Their experience has been that more subjective discomfort (usually in the alimentary tract) follows the oral than the intravenous administration of the dye. Vomiting and diarrhea raise a doubt as to whether or not sufficient dye is absorbed from the alimentary tract to give dependable data as to its concentration in the gall bladder. Phentetiothalein sodium is valueless as a test of liver function when given orally, because the quantity of dye absorbed is unknown. Cholecystographic estimation of the condition of the gall bladder is based on the fact that the normal organ receives the dye, concentrates it, alters in size (or shape), and finally evacuates its contents. This sequence can be assured only if the organ is at rest during the foregoing cycle. A diseased gall bladder has its functions interfered with, and the departure from normal behavior is proportional to the degree of impairment of the organ. The test reveals anatomic changes only coincidentally or inferentially.

The fat meal is not used for testing the emptying capacity of the gall bladder, experience indicating that if the organ is visualized it will empty itself; also, that any impairment of its wall that might affect the organ's ability to void its contents would have as concomitants obvious deviation from the normal cholecystographic behavior. In disease of the liver, of such extent that the gall-bladder function is affected, there would scarcely be occasion to attempt cholecystography, as the diagnosis would probably be obvious. Acute disease of the biliary tract is a contra-indication to cholecystography. In pericholecystitis of intrinsic origin, there is a total absence of the concentrating function of the gall bladder. In pericholecystitis of extrinsic origin, there is an approximately normal concentrating function of the gall bladder, with rarely demonstrable deformity or fixation of the organ. Pericholecystitis is dealt with at length for the reason that it has many pitfalls in cholecystographic interpretation.

There is a type of stone found in the gall bladder with normal function which is not otherwise discernible, the so-called negative or cholesterol stone. Because of the experience with calcified stones, radiographic search for them precedes cholecystography. Low in the scale of accuracy of pre-operative diagnosis is the cholecystogram which reveals a gall bladder with a deficiency of the concentrating function, having a "thin" or "faint" shadow. The persistence of the shadow beyond a twenty-four-hour period is so dependent on food intake and activity that its diagnostic importance has dwindled virtually to the vanishing point. The gall bladder that is promptly visualized, concentrates the dye, and empties without delay in the oral method is a normal gall bladder. Any deviation from this behavior, when the oral test is employed, should be followed by an intravenous test.

CHARLES G. SUTHERLAND, M.D.

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**Biliary Tract Visualization with Radiopaque Oils. Richard H. Overholt. Surg., Gynec. and Obst., January, 1931, LII, 92.**

The use of radiopaque solutions to define the biliary ducts after a drainage operation has proved of sufficient value during the past year to warrant the publication of the results of such a procedure. The more limited the exploration at the time of operation the greater this uncertainty. A definite knowledge of the patency of the biliary duct system is required in the proper post-operative management of the case, such as the determination of the time for withdrawal of the T-tube, and in giving a prognosis as to the probability of a persisting biliary fistula. The determination of obstruction of the common duct before the T-tube is withdrawn is also important if a second operation is required, as the common duct is more easily located if the T-tube is left *in situ*.

There are various indirect ways of gaining

information about the condition of the common biliary duct after operation. However, in some patients these criteria are not reliable. During the second or third week after operation, the patient is placed on an adjustable fluoroscopic table. The gall-bladder drainage tube or common duct tube is then injected with the opaque material, under fluoroscopic control, the amount varying from 15 to 20 cubic centimeters, depending upon the manner in which the biliary system fills. No force is required to make the injection as the solution will practically run into the ducts by the force of gravity.

Campiodol (iodized rapeseed oil) was found to be a safe and satisfactory visualizing medium. When a complete or partial obstruction of the common duct was noted, the drainage tube was clamped following the injection, and fluoroscopic examinations made at intervals over a period of from 30 to 40 minutes. In some a duodenal tube was passed, and a solution of magnesium sulphate was injected. In no instance was there an untoward result following the injection of the biliary system. In the patients in whom no obstruction to the emptying of the common duct existed, the campiodol passed immediately through the duct and into the duodenum. At times the flow of the oil would be checked at the ampulla momentarily, during which interval, waves in the common duct seemed to sweep the oil toward the hepatic ducts, before it would enter the duodenum. In such cases, however, the hepatic ducts filled poorly and the common duct incompletely. Roentgenograms showed the opaque medium scattered in the upper jejunum. It is well, for this reason, to make a large enough exposure to include both upper quadrants of the abdomen.

When an obstruction existed in the common duct, this duct as well as the hepatic ducts promptly filled and were clearly visualized. The position, contour, and size of these ducts were clearly determined. Incomplete common duct obstruction in some cases was evidenced by a filling of the duct system, with only small expulsions of oil into the duodenum. When contraction waves were seen in the common duct, with obstruction present, there was a tendency for the opaque medium to be forced higher in the hepatic ducts.

The injection of a cholecystostomy drain, with obstruction of the common duct, showed the gall bladder, cystic and hepatic ducts. If there was no obstruction, the gall bladder and ducts filled poorly and immediate entrance of the campiodol into the duodenum was noted. This information was especially important as it was in such cases that exploration at the time of operation was unwise. In cases in which the common duct obstruction had existed for a long period of time, a dilatation of the hepatic ducts could be demonstrated. In the author's cases the degree of hepatic duct dilation corresponded closely to the degree of liver drainage as estimated by the biliary output, the change in the Van den Bergh reaction, and the duration of the convalescence.

D. S. CHILDS, M.D.

## GASTRO-INTESTINAL TRACT (DIAGNOSIS)

**On Great Gastric Retention and Dilatation of the Stomach in Cases of Gastroduodenal Ulcer and Cancer of the Stomach. T. Klason. Acta Radiologica, 1930, XI, Fasc. 4, No. 62, p. 444.**

The author analyzes his cases of gastroduodenal ulcer and gastric carcinoma seen in the past five years. Of 451 cases of ulcer, 258 were duodenal, and 193 were gastric. He found gastric retention in 11 per cent of the duodenal ulcers and in 5.7 per cent of the gastric ulcers. Of the 201 cases of gastric carcinoma, retention was found in 14.3 per cent, being, of course, most common in the antral lesions. The author calls attention to the fact that in obstructing carcinoma of the pyloric end of the stomach the tumor is better demonstrated at four hours than immediately after the barium meal.

M. J. GEYMAN, M.D.

**Acute Ulcerations of the Stomach in Children. Benjamin Rice Shore. Ann. Surg., August, 1930, XCII, 234.**

A female infant, aged 22 months, had frequent vomiting for thirty-six hours. It died at operation, with an acute perforated ulcera-

tion of the stomach wall, the ulcer being situated on the posterior wall near the fundus of the stomach. There were no signs of chronic ulcer present. The markedly hemorrhagic edges of the necrotic area suggest that the primary lesion was one of hemorrhage, either from local injury, overdistention, or vascular thrombosis, and that gastric digestion in this area caused the perforation.

The etiology of acute ulcers is discussed. Congestion, embolism, thrombosis, vascular disease, direct injury to the mucosa, and nervous influences are considered.

F. B. MANDEVILLE, M.D.

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**Gastric and Duodenal Ulcers. L. O. Nordstrom. Jour. Kansas Med. Soc., September, 1930, XXXI, 316.**

The diagnosis of peptic ulcers in well developed and uncomplicated cases is comparatively easy, but in early cases and when complications cloud the picture, diagnosis is often most difficult. Roentgen-ray examinations are positively necessary for a correct diagnosis. Not only may a positive diagnosis of ulcer be made when a niche is present, but definite information as to the size, shape, position, and motility of the stomach, may be gained.

W. W. WATKINS, M.D.

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**Contribution to the Knowledge of Ulcer of the Extra-bulbar Portion of the Duodenum. Rodolfo Viviani. La Radiologia Medica, June, 1930, XVII, 698.**

A survey of the contemporary literature discloses very few references to ulcers of the extra-bulbar portion of the duodenum. The author reports the radiological examinations of four cases. The main difficulty encountered in the clinical diagnosis of this lesion is the lack of characteristic symptoms which would indicate its exact position. The radiological manifestations are, instead, fairly well determined. The author, after a detailed study, is led to the following conclusions:

*(a)* The positive signs of the ulcer are: (1) ulcer niche; (2) general deformity of the duodenum, consisting of a stenosis around the orifice of the niche and of a disappearance of the shadows of the duodenal ridges; (3) the presence of a spasm in front of the image of the ulcer.

*(b)* A diverticular image of the extra-bulbar portion of the duodenum may be interpreted as an ulcer and differentiated from other affections when a complete study is made of the alterations of the walls of the intestines.

*(c)* Although the niche is the most significant of the radiological signs, other anomalies of the duodenum may disclose peculiar characteristics of an ulcerative process. In doubtful cases, however, a positive diagnosis must be supported by clinical symptoms.

*(d)* The analogies existing in the radiological images of the alterations of the different portions of the gastro-enteric tube, in which an ulcer may be located, show how the intestinal canal responds, with constant and peculiar pictures, to the anatomic condition of the area affected.

*(e)* The fact that an ulcer of this portion of the duodenum is not so rare an occurrence as is frequently thought ought to lead the radiologist to an accurate and systematic study of the entire duodenal area.

L. MARINELLI.

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**Peptic Ulcers: Diagnosis and Treatment. Philip King Brown. California and Western Med., November, 1930, XXXIII, 804.**

The author discusses the etiology, medical treatment, subjective symptoms, and particularly the value of the X-ray in diagnosis and treatment. When the X-ray reveals a typical deformity, with a six-hour retention, and there is a characteristic history of pain after food, with occult blood in a milk residue stool, the author believes it is foolish to say nothing is wrong. When, with a clinical and X-ray diagnosis of ulcer, the surgeon complains that he has failed to find the ulcer at operation, the case has not been properly studied or the operation properly conducted.

Retention, evidenced by distress, lack of appetite, loss of weight, nausea, vomiting, etc., and confirmed by the X-ray, does not necessarily call for surgery. Cleaning out such a stomach and the Lenhartz diet will usually steadily reduce the retention. The author's plan is to re-check in twelve days, with grad-

ually increased diet. As much as a 50 per cent retention from ulcer has disappeared in that time. A few cases, not good operative risks, have had the rest and diet continued a month or even more, and he is gratified to find that it is worth while often enough to give it serious consideration.

F. B. SHELDON, M.D.

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**Syphilis of the Stomach—A Study of Eight Cases. John B. Fitts. Ann. Int. Med., December, 1930, IV, 628.**

During a period of eight years there were 35,000 patients admitted to the hospital, with eight cases of gastric syphilis.

The X-ray signs of gastric syphilis are as follows:

1. A concentric, symmetrical defect of the gastric lumen.
2. The stomach appears high, with narrowed lumen.
3. If the lesion is antral, it appears in a narrowed tubular effect.
4. If the lesion is of the hour-glass type, the isthmus of the hour-glass is elongated and dumbbell-like.
5. The pylorus may be gaping, or, less frequently, obstructive.
6. Six-hour residues are found only in the obstructive type.
7. The technical point of differentiation from carcinoma lies in the fact that the syphilitic lesion is symmetrical, while the carcinomatous is asymmetrical and irregular.

Syphilis may involve the stomach in three ways, namely, (1) diffuse syphilitic gastritis; (2) syphilitic ulcer; (3) gummatous infiltration. The symptoms present in gastric syphilis are pain, vomiting, loss of weight, positive Wassermann, and characteristic X-ray findings.

C. H. DEWITT, M.D.

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**Psychogenic Factors in the Etiology of Ulcerative Colitis and Bloody Diarrhea. Cecil D. Murray. Am. Jour. Med. Sci., August, 1930, CLXXX, 239.**

In this article, the author reviews a series of 12 cases of ulcerative colitis and bloody diarrhea, with special reference to psychogenic factors in their etiology. He cites a number of cases in which there is a rather startling relation between the onset of the disease and the outbreak of emotional disturbance, the first mucus shreds or the first blood appearing in the stools at times of emotional stress. He gives complete histories of four cases in which this relation was most striking that tend to show how serious the physical condition may become in one or more of the following circumstances, namely: (1) if the emotional conflict is deep-seated or chronic or not easily settled; (2) if there is a specific organism, and, vague though it is, we must add, (3) if the individual is predisposed in some way by heredity, early training, general physical or nervous makeup, etc., to colon afflictions.

He compares this last to the fear component in cases of gastric ulcer, emphasized by Draper and McGraw *(Am. Jour. Med. Sci., 1927)*.

The outstanding trait in colitis patients besides fearfulness is their emotional immaturity, and in this respect they differ from the gastric ulcer individuals.

The author finds that mental conflicts concerned with marriage were more commonly found than other types of situations which might evoke anxiety. In each case, the patients faced their problems in an inadequate, infantile manner. He feels that if the pathologic process has not progressed too far, a thorough investigation into the patient's life and mental attitude may afford opportunity for much needed psychotherapy.

ROE J. MAIER, M.D.

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**The Irritable Colon. John Muir. British Jour. Radiol., September, 1930, III, 391.**

The author attempts to show that evidence of gastric irritation may be found not merely with such extrinsic causes as pathologic gall bladder, appendix, etc., but that the same finding may be co-existent with no extrinsic organic lesion, but only a similar state of irritation of the colon. Localized pylorospasm is considered more significant than generalized hypertonicity or hyperperistalsis, as regards colon irritability. The signs of irritable colon are given as follows: (1) tenderness distrib-

uted along the course of the colon, often accentuated over the middle of the transverse or over the descending portions; (2) exaggerated and irregular haustration or segmentation; (3) inconstant dilatation of the proximal colon, and (4) by enema study of hypermotility through certain segments, most often the pelvic and descending portions. The author urges caution in the interpretation of irritability of the colon, since there are such wide variations within normal limits, but at the same time calls attention to the extreme variability of the roentgen findings as the clue to absence of organic intrinsic lesions and the presence of irritability only.

J. E. HABBE, M.D.

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**The Roentgenologic Demonstration of a Gastric Myoma. Hans Gebhardt. Röntgenpraxis, Oct. 15, 1930, II, 913.**

The diagnosis of benign tumors of the stomach has been greatly furthered by the roentgenologic examination, using small amounts of barium, and compression. It is possible to reach a diagnosis of a benign gastric tumor in quite a number of cases by this examination, especially if one observes the behavior of the surrounding mucosa. A case is described in detail which presented a definitely outlined, well circumscribed, round filling defect in the corpus of the stomach, with a normal mucosa surrounding it. Operation proved that this tumor was a myoma.

H. W. HEFKE, M.D.

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**Radiological Diagnosis of Duodenal Ulcer. Paolo Buisson, Marco Bermond, and Mario Buisson. Minerva Medica, April 14, 1930, I, 599.**

The most reliable method to adopt for a diagnosis of duodenal ulcer is a series of radiographs. Fluoroscopy, while not entirely satisfactory, is superior to any clinical examination and is to be considered, in some cases, as a supplement to radiography.

The authors analyze the fluoroscopic factors (gastric hypertonia, Kreuzfuchs' sign, pyloric insufficiency, temporary spasm of the pyloric region, etc.) which may be noted in a case of duodenal ulcer. They point out the inadequacy of such examination by discussing other gastric affections which would present the same fluoroscopic characteristics. Clinical examination and history are to be resorted to only when more factors of differentiation are needed because they cannot, by themselves, supply any definite criterion except for the most evident cases.

As for radiographic signs, it is advisable to consider two series. The first shows a pathological stage of the pyloro-duodenal region, but it cannot lead to an unquestionable diagnosis. It consists of such anomalies as eccentric position of the pylorus, with respect to the duodenal bulb, the pyloro-duodenal "dextro-fixation," and the bulbar ante-position *et similia*. The second series consists of the positive pathognomonic signs of duodenal ulcer, namely, the niche, the cicatricial deformation, Akerlund's pseudo-diverticulum, and the "encoche" or "bulbous defect." The authors consider the persistency of the shape and position of these images as the most reliable factors, and illustrate their detailed discussion by reporting 21 cases (out of 300 studied), with an extensive radiographic repertoire.

L. MARINELLI.

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**X-ray Examination in Acute Intussusception. Einar Edberg. Acta Radiologica, 1930, XI, Fasc. 2, No. 60, p. 194.**

For twenty years the author has been interested in intussusception, but only in the last two years has he employed the X-ray examination in selected cases. The higher the intussusception, the more difficult is the diagnosis by opaque enema. The author's experience is that in pure ileal intussusception it is very hard to make any other pre-operative diagnosis than intestinal obstruction. He has found Meckel's diverticulum involved in a number of these cases.

Intussusception of the colon was the first form to be described from the roentgenographic viewpoint. Edberg feels the X-ray examination is of no great value in acute intussusception of the colon, but of much usefulness in chronic colic intussusception in adults. Seventy-five per cent of all intussus-

ceptions occur in children, and 75 per cent of these are in the vicinity of the ileocecal junction. The author describes two main types: (1) the ordinary ileocecal intussusception and (2) a variety which he terms the ileo-ileocolic. At X-ray examination one sees the head of the intussusceptum and the central column of barium mixture filling the outer column as a piston fills the barrel of a syringe. In ileocecal intussusception there is ordinarily a shell-shaped filling defect in the opaque column in the region of the invagination. The head of the intussusceptum may pass far into the colon. The colon distal to the lesion is usually tubular, with decreased haustrations. There is likely to be comparatively little accumulation of gas in the small intestine, even though ileus has existed for some time.

In ileo-ileocolic intussusception, the primary invagination occurs in a loop of the terminal ileum, and at first only the small intestine is involved. Usually this type of intussusception does not pass as far into the colon as the common ileocecal form. The invaginated part has more room than in the ileocecal type, and the peripheral portion looks like a stocking drawn over the swollen invagination. The opaque enema can pass between the middle and outer cylinders of intestine. The haustrations are small. The lower colon is tubular, but near the intussusception one often sees a beautiful relief of the mucous surface of the bowel. As a rule, there is more gas in the small intestine than in the ileocecal intussusception and meteorism appears much earlier.

The author states that he has compared the fluoroscopic appearance, the roentgenograms, and the operative findings in his cases, and that as a result he feels that a differentiation between ileocecal and ileo-ileocolic intussusception can be made by the X-ray examination. The importance of this is better understood in view of the fact that early ileocecal intussusception may often be reduced mechanically, whereas the ileo-ileocolic type should be operated upon immediately.

The author has been interested in attempts at reduction by barium enema. He has seen three cases of early ileocecal intussusception rapidly and completely reduced by the opaque enema. One of these patients was explored 24 hours after the reduction, and characteristic residual swelling and edema were found in the cecum. Another case showed almost instantaneous reduction of an intussusception that screen examination had shown to have reached the hepatic flexure; when symptoms recurred within a week, an operation was performed which disclosed a diverticulum in the terminal ileum and fixation of both the cecum and appendix. The fixation of the cecum prevented cecal invagination but permitted ready prolapse of the diverticulum into the colon. Cases of this sort may allow invagination of the ileum into the colon for a considerable distance; reduction is usually easy. Edberg has seen partial reductions under the screen which were not permanent.

At the end of the article the author reports 11 cases, 9 of which are under one year of age. Only one of the patients succumbed. The clinical history, roentgenograms, and operative findings are given in each instance. He concludes as follows:

(1) Simple ileocecal intussusception on roentgenograms shows a wide, shell-shaped filling defect in the barium enema at the site of the lesion, and only a small amount of gas in the small intestine even after a relatively long illness.

(2) Ileo-ileocolic intussusception shows the opaque medium in a thin layer about the intussusceptum, and gives the impression of an irregular, spiral filling defect in the barium column. The mucosal folds in the wall of the colon are visible. There is more gas in the small intestine than in the ileocecal type.

(3) When the primary intussusception occurs only a few centimeters from the ileocecal valve, a secondary invagination of the cecum occurs, and the roentgenographic appearance resembles that seen in ordinary ileocecal intussusception.

A. L. HART, M.D.

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**Stasis of the Cecum and Ascending Colon. L. D. Johnson. Jour. Kansas Med. Soc., September, 1930, XXXI, 322.**

Many patients complaining of pain in the right lower quadrant submit to operation with-

out obtaining relief. Many such cases are due to obstruction or stasis in the proximal colon, usually from some congenital defect, and the cecums are occasionally found to be greatly distended at the dependent part, containing a double band. There is usually a history of prolonged low-grade pain in the right iliac fossa, extending up to the right costal margin. Reflex stomach symptoms are frequent, such as nausea, epigastric pain, acid eructations, etc. The X-ray will tell the whole story. From 6 to 10 hours after a barium meal, the opaque material will be in the cecum, where it stays for from 48 hours up to several days. One case was observed in which it remained in the cecum for 14 days. The cecum and ascending colon cannot be emptied on palpation and the area of obstruction may be visualized. In patients who have previously had appendectomies and the symptoms still remain, the X-ray examination gives the same picture.

W. W. WATKINS, M.D.

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**The Clinical Diagnosis of Hypertrophic Syphilis of the Stomach. Heinz Baumecker. Med. Klinik, Oct. 17, 1930, XXVI, 1557.**

Syphilis of the stomach is a rare disease. It is seen in approximately only one out of ten thousand autopsies. The clinical diagnosis is very difficult. Symptoms from the stomach and a positive Wassermann reaction do not constitute enough evidence for this diagnosis. The roentgenologic findings are by no means so characteristic that one can depend on them. According to Carman and Hartwell, syphilis of the stomach should be suspected if the marked roentgenologic changes are out of proportion with a slight cachexia and anemia. Either an ulcer or a carcinoma (especially the scirrhous type) can give the same appearance as syphilis. The disappearance of clinical and roentgenologic findings after specific therapy, taken by some authors as proof, can be explained as caused by the diet régime, and self-healing of ulcers. Many cases of so-called syphilis of the stomach are not proved. The case of a thirty-two-year-old woman is described in detail. The roentgenologic diagnosis was carcinoma of the stomach. However, a laparotomy and a biopsy showed a chronic inflammatory lesion which was considered to be syphilitic.

H. W. HEFKE, M.D.

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**The Reaction of the Content of the Gastro-intestinal Tract. Frank C. Mann and Jesse L. Bollman. Jour. Am. Med. Assn., Dec. 6, 1930, XCV, 1722.**

The various digestive enzymes that are poured into the gastro-intestinal tract require different chemical reactions of the gastro-intestinal content for optimal activity. These reactions vary from one definitely acid for the stomach to one neutral or slightly alkaline for the remaining portion of the gastro-intestinal tract. The changes in reaction of the gastro-intestinal content, as it passes through the gastro-intestinal tract, necessitated because of the needs of the various enzymes, have formed the basis for many physiologic problems and have offered the possibility for the development of certain pathologic conditions. The actual changes in the acidity of the gastro-intestinal content and following various diets are in themselves of considerable physiologic value. The mechanism whereby the changes are graded as the content passes, for instance, from the acid secretion in the stomach to the neutral or alkaline secretion in the duodenum, also raises problems of considerable physiologic significance.

Supplementing the experimental production of peptic ulcer by Mann and Williamson, it was necessary to determine whether the theoretical considerations that made possible the development of a successful method of producing chronic peptic ulcer were correct. In order to determine this, it was necessary to observe the changes in acidity taking place in the gastro-intestinal tract, particularly at the pylorus and in the duodenum, at frequent intervals, over long periods of time, in the fasting state, and following the ingestion of various types of food. An exceedingly satisfactory method was developed, and this is described in detail. Estimation of the acidity in the fasting animal showed the gastric juices usually strongly acid, but at times almost neutral.

The content of the duodenum, jejunum, ileum, and colon is usually alkaline, with the exception that the content of the duodenum may be acid when highly acid values are found in the content of the stomach. Following a meal, the acidity of the content of the gastro-intestinal tract depends largely on the development of acid in the stomach. Short periods of high acidity of content are common in the duodenum and less common in the small intestine, the greater the distance from the pylorus. The usual reaction in the small intestine, after a meal, is close to neutral. The content of the colon is usually slightly alkaline, but may be slightly acid, especially following a meal rich in carbohydrate. Dietary measures may greatly alter the acidity of the content of the gastro-intestinal tract.

C. G. SUTHERLAND, M.D.

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**The Roentgenologic Appearance of a Subphrenic Abscess on a Post-appendiceal Basis. Oskar Meller. Röntgenpraxis, Dec. 1, 1930, II, 1071.**

The clinical diagnosis of a subphrenic abscess is often very difficult to make. A roentgen examination may be of great value. A high diaphragm, gas under the diaphragm, and a fluid level which shifts with the position of the patient, are findings which permit a definite diagnosis. Occasionally one may demonstrate a deformity of the hepatic flexure of the colon by means of a barium enema, indicating a contact of the abscess with the wall of the colon.

H. W. HEFKE, M.D.

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**Acute Intestinal Obstruction. Irvin Abell. Jour. Am. Med. Assn., Dec. 20, 1930, XCV, 1903.**

A study of accumulated statistics reveals that, while acute intestinal obstruction carries an inevitable mortality, the greater portion of the mortality may justly be attributed to delay in recognition and to tardiness in the institution of appropriate surgical treatment. The underlying fact, with which all adjuvants must be correlated, is that the obstruction is mechanical and must be corrected mechanically. The presence of abdominal pain, vomiting, and constipation, with an absence of fever and leukocytosis, should put the burden of proof on the medical attendant to show that no obstruction exists. The flat roentgenogram, interpreted by a competent roentgenologist, in addition to the three cardinal symptoms mentioned, should permit of a working diagnosis before the accession of fever, leukocytosis, distention, and paresis indicate changes brought about by strangulation and chemical changes of the blood show profound alterations.

In the discussion of a series of papers, Case interestingly discussed the technic of the roentgenologic demonstration of acute intestinal obstruction by the flat film and the administration of a small quantity of barium in a dextrose-water mixture by mouth to visualize the small intestine.

C. G. SUTHERLAND, M.D.

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**Gastric Ulcer with Gastritis in a Ten-year-old Child. Franz Herz. Röntgenpraxis, Dec. 1, 1930, II, 1077.**

Gastric ulcers in children are rare. Such a case in a ten-year-old child is described, with special reference to the roentgenologic findings. A crater could be demonstrated at the lesser curvature, close to the cardia.

H. W. HEFKE, M.D.

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**The Diagnosis of Gastric Lesions by Intragastric Photography: Preliminary Report. Reuben Finkelstein. Ann. Int. Med., January, 1931, IV, 804.**

While lesions along the curvatures are readily diagnosed by the X-ray examination, lesions of the walls are more difficult, or impossible, of diagnosis.

The development of intragastric photography makes possible an accurate diagnosis of lesions which would otherwise be difficult of diagnosis.

The gastro-photor consists of a semiflexible tube carrying at its distal end a double camera, an upper and a lower, between which is a small electric bulb so constructed that when activated by a transformer it yields a bluish-

white light of 12,000 candle power for 1/120 of a second, and is then destroyed. The transformer takes its energy direct from the house-lighting current.

Each camera contains four small films regularly disposed in a circle, and by means of two pinpoint holes, upper and lower, a stereoscopic picture is taken by each film of a 90-degree arc of the circumference; thus at each exposure eight double stereoscopic views are taken. Films are marked so that one can tell what part of the circumference of the stomach is shown on the film. A full description of the technic employed is given. The author arrives at the following conclusions: "Like all other means of diagnosis it is not infallible, and will not replace the X-ray or clinical evidence of gastric disease. There are, however, a large number of cases in which the diagnosis cannot be made and only a gastro-photor picture will reveal the lesion."

C. H. DeWitt, M.D.

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**A Contribution to the Diagnosis of an Obstruction in the Upper Small Intestines. C. Wittkowsky and Metzger. Röntgenpraxis, Nov. 15, 1930, II, 1042.**

A case of an adenocarcinoma of the jejunum is reported on account of the rare occurrence of such tumors. The roentgenologic examination showed a definite but incomplete obstruction and dilatation of the upper jejunum. Operation and autopsy confirmed the diagnosis.

H. W. Hefke, M.D.

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**Acute Intestinal Obstruction. Frank Smithies. Jour. Am. Med. Assn., Dec. 20, 1930, XCV, 1899.**

When acute intestinal obstructions are suspected, roentgen studies are to be condemned if they include the employment of barium mixtures. Four patients of the author's series had X-ray progress meals administered after there had accumulated sufficient proof, clinically, that an acute abdominal lesion existed. In all instances, the stimulus of the opaque meal, combined with the weight of the digestively inert barium, resulted in the acute intestinal obstruction being converted into acute intestinal perforation. Only one patient recovered. At times, certain valuable information may be secured by the roentgen study of gas-filled loops of bowel. In the films it may be possible to demonstrate approximately where the obstruction lies; at least, one may state, with fair accuracy, that the obstruction is in the small and not in the large bowel. There are instances in which sufficiently sharp gas shadows will enable a definite diagnosis of jejunal, in contra-distinction to an ileac, obstruction.

If roentgenographic studies can be made without loss of time and undue moving about of the patient, they should form a part of every routine examination. Not only may these "scout films" give information that is valuable diagnostically, but a study of the gas shadows may prove of great help in aiding the surgeon to better plan his operative procedure. When perforation of the bowel has already taken place, and when the patient had previously been taking medicine, such as bismuth, the shadow cast by the escaped opaque substance may indicate where the perforation is. In such circumstances, films serve as a caution against immediate operation. Proof of free-lying bismuth shown roentgenologically, suggests a waiting policy that may save the patient's life.

C. G. Sutherland, M.D.

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**The Incidence of Hemorrhage in Perforated Gastric and Duodenal Ulcers. Moses Behrend. Jour. Am. Med. Assn., Dec. 20, 1930, XCV, 1889.**

Ulcers of the stomach and duodenum manifest themselves in various ways. They are selective in their location, time of perforation, and incidence of hemorrhage. "Perforated ulcers rarely bleed and bleeding ulcers rarely perforate." The varying degrees of morbidity caused by ulcers depend, to a large degree, on their location. The author's research findings coincided with those of Einhorn, namely: "The arteries in the submucosa in the pyloric region of the lower lesser curvature of the stomach are practically terminal vessels and are relatively sparsely distributed, giving a limited blood supply to this area. They are

tortuous, anastomose infrequently, and are subject to powerful and repeated forcible contractions by numerous interlacing, intrinsic, and frequently contracting muscle bundles. These constrictions tend to interfere with the circulation and, moreover, the terminal vessels are subject to the same tendency to circulatory interference by reason of easy blocking, as are the terminal vessels in the brain, or kidney, and are especially liable to harbor the foci of anemia."

Ulcers that give rise to hemorrhage are more apt to occur in the pliable elastic tissue of the stomach than in the dense area around the pylorus. No definite place can be assigned to this type of ulcer. There is some difference of opinion whether surgeons should or should not operate. In the author's opinion, it is an error of judgment to defer operation in hope the ulcer may not bleed again. Perforated ulcers occur more frequently than bleeding ulcers. The bleeding ulcer is usually an acute condition, hence the area affected is much smaller in extent. It is interesting to note the gross pathologic differences *in vivo* between the chronic ulcer, the perforating ulcer, and the bleeding ulcer.

C. G. SUTHERLAND, M.D.

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**Sigmoidoscopy *versus* X-rays in the Diagnosis of Terminal Bowel Disease. Frank C. Yeomans. Jour. Am. Med. Assn., Dec. 20, 1930, XCV, 1907.**

Refinements in the technic of roentgenology and improvements in proctoscopes have made these two agents prime factors in the diagnosis of gastro-intestinal diseases. Each method has its indications, advantages, and limitations, and frequently the two are materially helpful in arriving at a correct diagnosis. In the relatively fixed rectum and distal sigmoid colon, which are situated largely within the bony pelvic girdle, the X-rays are of comparatively limited value. Prominent defects are: (*a*) an important lesion may be missed entirely; (*b*) although the site and apparent extent of a lesion are discovered, especially if it is of a stenosing character, its nature is frequently not disclosed; (*c*) in many cases, interpretation of the image is so uncertain as to cast grave doubts on the diagnosis. For example, amebic colitis in its early stages or before secondary infection of the ulcers has occurred, may present the same symptoms and roentgenologic appearance as ulcerative colitis, but viewed through the proctoscope, the early lesions are characteristic and pathognomonic. In examination of the terminal bowel the usual order of procedure should be reversed, sigmoidoscopy being first in order. Endoscopy usually establishes the diagnosis of lesions in the rectum and the pelvic colon. Negative endoscopic observations are valuable data for the roentgenologist. The X-ray comprises the best available agent for determining the extent of involvement in ulcerative colitis, and in detecting tuberculosis of the cecum; it is our chief reliance in demonstrating diverticulosis of the colon, and especially diverticulitis of the sigmoid, and, rarely, it may discover a double primary carcinoma in different colonic segments.

C. G. SUTHERLAND, M.D.

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**A Contribution to the Roentgenologic Diagnosis of Ulcerative Colitis. Hans J. Teschendorf. Röntgenpraxis, Dec. 1, 1930, II, 1087.**

The roentgen examination of the colon by means of a barium enema is of great clinical significance in the diagnosis of ulcerative colitis. The results are better when the films are taken after the patient has expelled the enema, as the "relief" of the mucous membrane is more clearly demonstrated. The method of A. W. Fischer (combination of barium enema and air inflation) gives plastic pictures, but does not show the mucous membrane.

H. W. HEFKE, M.D.

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**Diet in Chronic Gastric Ulcer. Editorial. Jour. Am. Med. Assn., Dec. 13, 1930, XCV, 1838.**

In the words of the editorial writer: "The successful treatment and healing of gastric ulcers involves many factors of uncertainty, reflected in the multiplicity of suggestions from therapeutists. For example, a recent writer asserts that the establishment of proper habits of eating, the avoidance of notoriously

irritating articles of food which offend the gastric organ because of chemical, mechanical, or thermal insults, the minimization of worry, strain, and hurry—at least at meal times—the removal of infection from teeth, tonsils, and accessory sinuses, the prevention of chronic constipation by regulation of diet and exercise, and the surgical removal of disease elsewhere in the abdomen, are measures that tend to lower the incidence of ulcer. He adds that these are essential features in the treatment of ulcer whether or not surgery is employed. . . . . Experimentation is singularly difficult in human cases; hence it is proving to be of great advantage that characteristic gastric ulcer can be developed with considerable success in experimental animals. In the latter it has been observed that relative hyperacidity and hypernormal secretion, such as are associated with partial pyloric stenosis, are not necessarily such important factors in the delay of healing as was formerly assumed."

He continues: "Mechanical factors, however, can delay the healing of an acute lesion of the gastric mucosa, and acids make the ulcer more irritable or susceptible to bleeding. Fauley and Ivy have further pointed out that coarse particles of food remain in the stomach longer than fine particles, which obviously results in more prolonged motor activity of the stomach and increases the trauma to an acute lesion of the mucosa. This would be pronounced in a patient with pylorospasm. In studies at the Northwestern University Medical School, Chicago, they have demonstrated that certain types of acute experimental lesions of the gastric mucosa are definitely harmed by a "rough" diet. For instance, a simple ulcer of the rabbit's stomach, produced by excision, heals within thirty days, irrespective of the consistency of the diet. A similar ulcer, but with a silk suture in its base, will heal if the rabbit is fed a soft diet, but will tend to become chronic if the rabbit is fed a "rough" diet. Therefore, Fauley and Ivy conclude that in chronic ulcer in man a soft diet would facilitate the healing of an ulcer, which confirms clinical experience and supports the use of a diet of the character of that employed in the generally accepted therapeutic procedures for gastric ulcer."

C. G. SUTHERLAND, M.D.

**A Contribution to the Roentgenologic Diagnosis of Chronic Obstruction of the Small Intestines. G. Lemmel. Röntgenpraxis, Nov. 15, 1930, II, 1034.**

The roentgenologic study of pathologic lesions of the small intestines has not been developed as much as in the case of the stomach, duodenum, and colon. It is necessary to examine the small intestines frequently after a barium meal, over twenty-four hours or more. A definite localization of the obstruction and its nature may thus be reached in a large percentage of the cases. The horizontal fluid level, with gaseous distention of the small intestines, fixation of some loops, and distention with barium, are all only indirect symptoms. The demonstration of the obstruction itself gives a much better chance for a precise diagnosis.

H. W. HEFKE, M.D.

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**Roentgen Diagnosis of Ascariasis. Vincent W. Archer and Charles H. Peterson. Jour. Am. Med. Assn., Dec. 13, 1930, XCV, 1819.**

In September, 1929, during a routine roentgen gastro-intestinal examination of a child, certain signs were correctly diagnosed as being caused by *Ascaris* in the intestinal tract. No reference was found in the English literature, so experimental work was started on a group of children infected with *Ascaris*. A subsequent search of the foreign literature revealed several references. The ova from polluted soil are ingested and hatch in the small intestine. The larvæ migrate through the intestinal walls, enter the circulatory system, and are carried to the capillaries of the lungs. Here they develop in the air sacs, give rise to pulmonary changes, pass up the bronchial tree, and are swallowed. After liberation from the lung, about six weeks is required for maturity. A constant supply of fresh larvæ is being supplied by the lungs, even after an anthelmintic has cleared the intestinal tract of parasites.

A series of 60 patients, with stools positive for *Ascaris* ova, were studied roentgenologically. Of 57 children, 54 showed the very definite, typical roentgen appearance to be

described. Only one of the adults showed this. Films are made at one, two, and four hours. At first there are cylindrical filling defects, especially in the jejunum, from 5 to 8 mm. in diameter, and from 15 to 20 cm. in length. Later films show string-like shadows in the central portion of the filling defect. These are interpreted as the barium-filled enteric canal of the parasite. An interesting incidental observation has been that the parasites will not ingest the barium if the patient has eaten prior to drinking the contrast meal, and consequently the enteric canals will not be outlined. Roentgen evidence is occasionally definite in the absence of ova in the stool.

C. G. SUTHERLAND, M.D.

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**The Origin of Polypi of the Large Bowel, with Especial Reference to Adenoma: Preliminary Report. W. A. Fansler. Jour. Am. Med. Assn., Dec. 27, 1930, XCV, 1969.**

Polypi may occur in almost any portion of the intestinal tract, but approximately 75 per cent occur in the large bowel. Broadly speaking, any pedunculated tumor extending into the lumen of the bowel may be termed a polypus. Of the most unusual types may be mentioned fibromas, lipomas, and myxomas arising from the areolar tissue of the bowel wall; myomas, arising from the muscular coats, and hemangiomas, arising from the blood vessels. Post-sacral dermoid cysts and meningocele may arise outside the bowel and protrude into the lumen of the intestine in a polypoid fashion. Occasionally there is a polypoid growth due to parasites. A second group has to deal with the epithelium of the large bowel. A type is seen in cases of ulceration of the large bowel due to ulcerative colitis, amebic dysentery, syphilis, tuberculosis, and other inflammatory conditions. These are in no sense true tumors, as there is no growth of epithelial tissue.

A second type is the adenoma or adenomatous polyp. These tumors are true adenomas, whose epithelial structure is derived from the cells of the intestinal mucosa. They protrude into the bowel lumen and eventually become polypoid through the traction of their own weight, the pulling of the fecal current, and the peristaltic action of the bowel itself. The adolescent (congenital disseminated) type is seen in the first two decades of life. Children usually have a single adenomatous polyp. The author has never seen a case in which the bowel was studded with numerous adenomatous polypi in a patient under 18 years of age. As a rule, single adenomas occur in the earlier years of life and multiple adenomas in the later years. It is fairly obvious that some tendency of an individual to form adenomas does exist. In some cases, a definite family tendency can be shown. Adenomas are frequently found in chronically inflamed areas, or the primary change may occur in the epithelial cells and the inflammatory change may be secondary. The fact that the mucosa adjoining the adenoma is frequently normal would point to this. The author believes that the tumor begins as an enlargement of a small submucous nodule of lymphoid tissue and the epithelium over it is normal. While the exciting cause or causes of the formation of adenomatous polypi of the large bowel are not definitely known, he is convinced that the earliest demonstrable pathologic change is not found in the areas of the mucosa lining the bowel, but as a nodule of lymphoid cells in the submucosal tissue.

CHARLES G. SUTHERLAND, M.D.

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## GASTRO-INTESTINAL TRACT (THERAPY)

**Visceroptosis: Its Clinical Significance and Treatment. Edward L. Bortz. Am. Jour. Med. Sci., July, 1930, CLXXX, 59.**

In 1885, Franz Glénard first described the condition now known as visceroptosis. Since that time numerous articles have appeared in the literature, emphasizing the importance and various phases of this condition.

The author has analyzed 100 cases, according to age, incidence, sex, chief complaints, physical findings, previous operations, organs involved, accompanying lesions of the pelvis, additional diagnoses, important factors in the production of visceroptosis, probable important factors in the production of symptoms, re-

sults of treatment, and complicating factors in unimproved cases. He has also analyzed the opinions of twenty leading radiologists in four different countries.

He arrives at the following conclusions:

(1) Visceroptosis is a condition of downward displacement of the abdominal viscera that may exist in individuals who appear to be in perfect health.

(2) The condition may be primary, that is, hereditary, or it may be acquired following somatic devastation from overwork, repeated pregnancies, prolonged disease, etc.

(3) In a series of 100 cases studied in the Lankenau Hospital Medical Clinic the chief symptoms have been analyzed here. They usually pointed to the gastro-intestinal tract.

(4) Satisfactory therapeutic measurers depend upon a consideration of the cause of the symptoms.

(5) In the Lankenau Clinic a definite daily program is planned for each patient including proper diet, elimination, rest, massage, and, when indicated, mild sedatives. All foci of infection are eradicated and, in selected cases, a Page abdominal support is applied. In a small percentage of cases requiring surgical intervention the fundamental *rationale* of the treatment should not be neglected.

ROE J. MAIER, M.D.

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**Subtotal Gastrectomy for Duodenal Ulcer: Ten Years' Experience and Clinical End-results. Alfred A. Strauss, Leon Bloch, J. C. Friedman, Jacob Meyer, and Morris L. Parker. Jour. Am. Med. Assn., Dec. 20, 1930, XCV, 1883.**

This study is based on the results of 221 subtotal gastrectomies for duodenal ulcer. It represents the combined opinions of a stomach-study group, composed of surgeons, internists, roentgenologists, pathologists, research fellows, and a member of the social service department. The latter member studied the economic conditions of peptic ulcer patients before and after medical treatment, as well as before and after operation. All chronic gastric ulcers should be treated surgically because of the difficulty of deciding whether or not a gastric lesion is an ulcer or beginning carcinoma, and of the possibility of fatal, or near fatal, hemorrhage. Every duodenal ulcer should have the benefit of at least one thorough medical treatment, irrespective of the patient's economic condition. In cases in which the ulcer is not bleeding or perforating, the patients are usually relieved of their symptoms after two weeks' rest in bed and the usually accepted routine medical management. If the roentgen examination shows a clover-leaf deformity of the duodenum, little can be expected from medical treatment. The majority of these are due to an ulcer on the posterior duodenal wall, perforating into and adherent to the pancreas. Experience has shown that these ulcers do not heal, as the patients suffer not only from the ulcer but from mechanical difficulties. Pathologically, in addition to the duodenal ulcer, there is often associated a cholecystitis and pancreatitis, aside from gallstones.

The authors have formulated two basic laws for the successful surgical treatment of ulcers: (1) That the pathologic tissue should be removed, including the first portion of the duodenum and the lower half of the stomach; (2) that the stomach must have a rapid, or quicker than usual, emptying time. Subtotal gastrectomy, in their opinion, is the only operation which fulfills these laws. The mortality in their series of surgical cases was 5.4 per cent. The clinical end-results showed 95 per cent symptom-free on no particular diet or medication, and the gain in weight has been from 15 to 50 pounds.

CHARLES G. SUTHERLAND, M.D.

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**The Results of Medical Treatment of Peptic Ulcer. Ralph C. Brown. Jour. Am. Med. Assn., Oct. 18, 1930, XCV, 1144.**

The forms of treatment, in general, used prior to 1915 were chiefly based on bland foods, rest in bed, hot fomentations, and minimal doses of alkalis. Sippy recognized the important influence of the digestive action of gastric juice on the unprotected raw surface of a gastric or duodenal ulcer. He advanced the theory that healing of peptic ulcer could best be achieved by elimination of the chemical digestive action. He suggested neutrali-

zation of free hydrochloric acid in the gastric content from breakfast until bedtime, with special emphasis on the control of any existing hypersecretion during the night hours. The application of this theory resulted in the hourly-feeding schedule and the intensive use of alkalis of various types.

Two facts have emerged from continuous clinical experience with ulcer-bearing individuals. First, that by far the greater proportion of gastric and duodenal ulcers can be healed by proper medical measures. Second, that these lesions tend to recur, either at the original site or in a different area of the stomach or duodenum. A survey has been made of all cases treated by Sippy and the author over a period of fifteen years. Questionnaires were sent to 1,900, and the replies made possible a study of 1,224 cases. The clinical data are reviewed; the roentgen data were available in only 1,036 cases. Duodenal ulcer was diagnosed in 923 cases, gastric in 77, and duodenal and gastric in 12. Of the 1,130 cases treated medically, 49.5 per cent were reported cured; 16.7 per cent satisfactorily improved, and 10 per cent moderately improved. In 20 per cent medical measures failed. Approximately 20 per cent of the patients with gastric and duodenal ulcers now being admitted to hospitals require surgical care. Because of the lack of basic knowledge regarding the etiology of ulcer, the inability of physicians to insure an ulcer-bearing individual against recurrence constitutes the most serious problem to be faced.

C. G. SUTHERLAND, M.D.